METRIC

MIL-HDBK-844A(AS)
30 December 2003
SUPERSEDING
MIL-HDBK-844(AS)
20 October 1992

DEPARTMENT OF DEFENSE HANDBOOK

# AIRCRAFT REFUELING HANDBOOK FOR NAVY/MARINE CORPS AIRCRAFT

This handbook is for guidance only. Do not cite this document as a requirement.

AMSC N/A

FSC 9130

# FOREWARD

This handbook is approved for use by the Naval Air Systems Command, Department of the Navy and is available for use by all Departments and Agencies of the Department of Defense.

Contact information for Naval Air Systems Command, Air 4.4.5:

Telephone:

| | |
|---|---|
| DSN | 757-3410/3409/3405, |
| Commercial | 301-757-3410/3409/3405 |

Telefax numbers:

| | |
|---|---|
| DSN | 757-3614, |
| Commercial | 301-757-3614 |

Message address:

COMNAVAIRSYSCOM PATUXENT RIVER MD//4.4.5//

Comments, suggestions, or questions on this document should be addressed to Commander, Naval Air Systems Command, AIR-4.4.5, Bldg. 2360, 22229 Elmer Rd., Unit 4, Patuxent River, MD 20670-1906 or emailed to Douglas.Mearns@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

# 1. SCOPE

1.1 Scope. The contents of this handbook are limited to general, technical, and operational information. Specific operating procedures and equipment requirements are contained in the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109. Accounting and stock control procedures are not included in this handbook or in the NATOPS manual. This handbook is for guidance only and cannot be cited as a requirement.

1.1.2 Purpose**.** This handbook provides basic information on the properties and characteristics of aviation fuels along with general information on the standards, equipment, and operating principles related to the handling of these fuels at Navy and Marine Corps activities. This handbook is designed to supplement the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, by providing background information and guidance on the requirements and procedures contained in the NATOPS manual.

1.1.3 Sources of information**.** The information contained herein has been derived from a number of diverse sources including the fueling experience of the Navy, Marine Corps, and commercial companies; the recommended practices of the American Petroleum Institute (API) and ASTM International; and the published findings of research activities.

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed below are not necessarily all of the documents referenced herein, but are those needed to understand the information provided by this handbook.

2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein.

INTERNATIONAL STANDARDIZATION AGREEMENTS

| | | |
|---|---|---|
| STANAG 1135 | - | Interchangeability of Fuels, Lubricants and Associated Products Used by the Armed Forces of the North Atlantic Treaty Nations |

DEPARTMENT OF DEFENSE SPECIFICATIONS

| | | |
|---|---|---|
| MIL-DTL-5624 | - | Turbine Fuels, Aviation, Grades JP-4, JP-5, and JP-5/JP-8 ST |
| MIL-N-5877 | - | Nozzle, Pressure, Fuel Servicing (Superseded by SAE AS5877; included for historical continuity) |
| MIL-PRF-25017 | - | Corrosion Inhibitor/Lubricity Improver (CI) |
| MIL-DTL-83133 | - | Turbine Fuels, Aviation, Kerosene Types, NATO F-34 (JP-8), and NATO F-35 |
| MIL-DTL-85470 | - | Fuel System Icing Inhibitor (FSII), High Flash (diethylene glycol monomethyl ether) (DiEGME) |

DEPARTMENT OF DEFENSE STANDARDS

| | | |
|---|---|---|
| MIL-STD-3004 | - | Quality Surveillance for Fuels, Lubricants, and Related Products |

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or www.dodssp.daps.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein.

DEPARTMENT OF THE AIR FORCE

| | | |
|---|---|---|
| T.O. 42B-1-1 | - | Quality Control of Fuels and Lubricants |

(Copies of these documents are available from the USAF Petroleum Office website or by contacting Naval Air Systems Command, AIR-4.4.5, Bldg. 2360, 22229 Elmer Rd., Unit 4, Patuxent River, MD 20670-1906; or email Douglas.Mearns@navy.mil.)

DEPARTMENT OF THE NAVY

| | | |
|---|---|---|
| NAVAIR 00-80R-14 | - | Crash, Fire and Rescue NATOPS Manual |
| NAVAIR 00-80T-109 | - | Aircraft Refueling NATOPS Manual |

(Copies of these documents are available from the Naval Air Systems Command, AIR-4.4.5, Bldg. 2360, 22229 Elmer Rd., Unit 4, Patuxent River, MD 20670-1906; or email Douglas.Mearns@navy.mil.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein.

AMERICAN PETROLEUM INSTITUTE (API)

| | | |
|---|---|---|
| API-1529 | - | Aviation Fueling Hose |
| API-1581 | - | Specification and Qualification Procedures for Aviation Jet Fuel Filter/Separators |

(Copies of these documents are available from American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005-4070; (202) 682-8000; or through their website at http://www.api.org.)

ASTM INTERNATIONAL

| | | |
|---|---|---|
| ASTM-D93 | - | Cup Tester Closed, Flash Point by Pensky-Martins |
| ASTM-D910 | - | Aviation Gasoline |
| ASTM-D1655 | - | Aviation Turbine Fuels |
| ASTM-D2276 | - | Particulate Contamination by Line Sampling of Aviation Fuel |
| ASTM-D3240 | - | Standard Test Method for Undissolved Water in Aviation Turbine Fuels |
| ASTM-D4057 | - | Petroleum and Petroleum Products, Manual Sampling |
| ASTM-D5006 | - | Fuel System Icing Inhibitors (Ether Type) In Aviation Fuel |

(Copies of these documents are available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959; (610) 832-9585; or through their website at http://www.astm.org.)

IATA - Dangerous Goods Regulations

(Copies of these documents are available from IATA, 703 Waterford Way, NW 62nd Avenue, Suite 600, Miami, FL 33126; (305) 264-7772; or through their website at http://www.iata.org.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE-AS5877 - Detailed Specification for Aircraft Pressure Refueling Nozzle

(Copies of these documents are available from www.sae.org or Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001; or through their website at http://www.sae.org.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the NATOPS manuals or STANAGs cited herein, the text of the NATOPS manuals or STANAGs takes precedence. In the event of a conflict between the text of this document and any other cited references, the text of this document takes precedence.

# 3. DEFINITIONS

3.1 Definitions. See Appendix D, Glossary.

# 4. ORGANIZATION AND TRAINING

## 4.1 Organization.

4.1.1 General. The allowances for a Fuel Division should include an adequate number of personnel who possess sufficient grade structure, training, and seniority to ensure responsible operation of facilities and equipment in response to any operational demand.

4.1.1.1 Organizational flexibility. The organization should be flexible enough to efficiently handle increased workload on short notice, which can best be accomplished by cross training and cross manning. Leave schedules and school attendance can be adjusted to accommodate workload peaks. Scheduled leave can be deferred if unexpected peaks are encountered. Lengthening working shifts and nonstandard duty section, including stand-by duty section assignments, should be last-resort measures.

4.1.1.2 Recommended organizational structure. Chapter 8 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, outlines a recommended standard organizational structure for Navy and Marine Corps fuel operations divisions. Shipboard organizational structures are established by applicable instructions, regulations and/or standard operating procedures.

4.1.2 Responsibilities and duties. The Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, delineates fuels responsibilities at shore activities. For shipboard operations, consult Shipboard Operation Regulation Manual 3120.32. For tactical refueling operations, refer to the appropriate instructions, SOPs, and NAVAIR 00-80T-109.

4.1.3 Shore activity fuels organization. The following paragraphs list the normal duties assigned to various personnel within a typical shore activity fuels organization.

4.1.3.1 Fuel Management Officer (FMO). The FMO directs and supervises integrated fuel operations. An FMO typically:

a. Estimates quantities of fuel products to be consumed and fuel service requirements.

b. Develops proposed fuel budget.

c. Performs contract administration services.

d. Prepares and revises the activity fuel instruction in accordance with the Aircraft Refueling NATOPS Manual and other applicable documents.

e. Prepares an oil spill prevention and countermeasure plan.

f. Prepares environmental impact statements for the U.S. Coast Guard on any procedural change and modification to plant facilities.

g. Plans and initiates military construction, repair, and improvement fuel projects.

h. Performs liaison with fuel service customers, activity departments, other governmental agencies, community officials, and commercial concerns.

i. Represents fuel interests on official boards and committees.

4.1.3.2 Assistant Fuel Management Officer (AFMO). The AFMO assists the FMO in the supervision of the integrated fuel operations and performs the following special duties:

a. Directs the quality assurance program for fuel products.

b. Manages the petroleum laboratory.

c. Directs entire fuel training program.

d. Supervises inspections.

e. Maintains inventory control.

4.1.3.3 Fuel delivery branch The employee placed in charge of the fuel delivery section or branch is normally delegated the following specific duties:

a. Delivery of aviation POL products alongside aircraft.

b. Operation of hydrants to fuel aircraft with engines idling (hot refueling).

c. Operation of aircraft defuelers.

d. Dispatching of personnel and/or equipment and maintenance of dispatch log.

e. Delivery of ground products on automatic fill basis or as requested.

f. Pickup of waste oil.

g. Operational maintenance of facilities and equipment.

4.1.3.4 Storage and transfer duties. The branch or section head in charge of fuel storage and delivery usually is assigned the following duties:

a. Receipt of POL products by pipeline, tanker, barge, tank car or tank truck.

b. Storage of products.

c. Operation of the distribution systems and transferring of products.

d. Operation of vehicle service stations.

e. Grass cutting in hazardous areas.

f. Receipt and storage of packaged POL products.

g. Operational maintenance of facilities and equipment.

4.1.3.5 Quality Surveillance (QS) branch. The QS branch normally performs the following:

a. Sampling POL products at point of receipt and in aircraft tanks.

b. Surveillance of fuel handling operations.

c. Surveillance of POL filtration, water removal, and monitoring equipment including the maintenance of pressure differential graphs.

d. Operation of the POL laboratory.

e. Inspection and surveillance of facilities and equipment including contractor-owned equipment.

4.1.3.6 Inventory branch. The inventory branch usually performs the following functions:

a. Estimates of POL requirements.

b. Scheduling of product deliveries.

c. Preparation of fuel requisitions for replenishments.

d. Maintenance of daily inventory records.

e. Processing of receipt and issue documents.

f. Monitoring of contract refueling fuel deliveries.

4.1.3.7 Training branch. The training branch normally performs the following duties:

a. Preparation of training guide.

b. Conducting classroom and on-the-job training.

c. Certifying qualifications and issuing certificates.

d. Maintenance of training and qualification records.

e. Reviewing and supplementing contractors' training program.

4.2 Training. The importance of proper training cannot be over-emphasized. It is essential to the safety of fuel handling operations that the personnel involved be properly trained. Historical records disclose that the instinctive reactions of experienced fuel operators during emergency situations have minimized personnel injuries, fuel losses, and the destruction of government property including aircraft. Conversely, the records show that the reactions of relatively untrained personnel, under similar situations, cannot be relied upon.

.

# 5. CHARACTERISTICS OF AVIATION FUELS

## 5.1 Introduction

5.1.1 General. The basic type of aircraft fuel in use at Navy and Marine Corps air activities is aviation turbine fuel. Aviation gasoline (AVGAS) is only available in limited quantities at certain air facilities. Knowledge of the basic properties and characteristics of aviation fuels is necessary to understand the importance of delivering the proper fuel to the aircraft. Such knowledge is also valuable in understanding the need for safety and caution in handling aviation fuels.

5.1.2 Manufacturing aviation fuels. Turbine engine fuels and aviation gasolines are petroleum products manufactured from crude oil by refineries. Both are classified as flammable liquids and will burn when ignited. Under the right conditions, they will explode with a force similar to that of dynamite. Death can result if the vapors of either type of fuel are inhaled in sufficient quantities and serious skin irritation can result from contact with the fuels in the liquid form. In liquid form, aircraft fuels are lighter than water, and in vapor form they are heavier than air. Consequently, any water present in the fuels will usually settle 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, thus increasing the danger to personnel and property. For safety and health considerations, both aviation gasolines and turbine engine fuels should be handled with equal caution. Additional information on the properties and characteristics of aviation fuels and their effects on the safe handling of these materials is contained in Section 6 of this handbook.

5.1.3 Compatibility with other materials. All aviation fuels are extremely good solvents. For example, AVGAS will dissolve common lubricants (such as oils and greases used in pumps, valve, packing, and other equipment) and can cause serious deterioration of many rubber materials. It is therefore extremely important that only materials specially designed, tested, and approved for use with aviation fuels be allowed to come into contact with fuels. Never use substitute greases, lubricants, packing, etc., on or with fuel handling equipment without first obtaining agreement from the cognizant technical authority for the piece of equipment in question.

5.1.4 Aviation fuel use. Aviation gasolines are used for piston-type (reciprocating) engines, which are similar to automotive engines in terms of their basic operating principle. Turbine engine fuels, on the other hand, are intended for use in an entirely different type of engine. In place of the pistons found in reciprocating engines, turbine engines comprise an air compressor, a combustor, and a turbine that they use to turn fuel into usable propulsion energy. Since these are completely different types of engines, they require different types of fuels for proper operation. The following paragraphs provide some specific information on each type of fuel.

5.2 Turbine engine fuels. While aircraft piston engines are sensitive to the fuel used and will operate safely and satisfactorily only on one grade of aviation gasoline, most aircraft turbine engines can use a variety of grades of aviation turbine fuels. The difference between the grades of turbine fuels is their volatility. Table I lists the more common grades of military and commercial aviation turbine fuels and provides a rough comparison of their volatilities through their flash points (see Appendix D) and freeze points (see Appendix D). Detailed information on the properties and requirements of each grade of fuel is contained in the applicable specification.

5.2.1 Comparison of volatilities. Although kerosene type turbine fuels, JP-5 and JP-8, are much less volatile than JP-4 and AVGAS, under the right conditions, such as severe agitation, mists that are as flammable and explosive as AVGAS can form. All aviation fuels should be handled carefully.

TABLE I. Grades of turbine engine fuels

| | **Grade** | **Specification** | **Fuel Type** | **NATO CODE** | **Freeze Point** | **Flash Point** | **Density (°API Gravity)** |
|---|---|---|---|---|---|---|---|
| Military | JP-5 | MIL-DTL-5624 | Kerosene (High Flash) | F-44 | –51 °F<br>–46 °C | 140 °F<br>60 °C | 36.0–48.0 |
| | JP-4 | MIL-DTL-5624 | Wide-Cut | F-40 | –72 °F<br>–58 °C | below –4 °F<br>–20 °C | 45.0 – 57.0 |
| | JP-8 | MIL-DTL-83133 | Kerosene | F-34 | –53 °F<br>–47 °C | 100 °F<br>38 °C | 37.0 – 51.0 |
| Commercial | Jet A | ASTM D 1655 | Kerosene | none | –40 °F<br>–40 °C | 100 °F<br>38 °C | 37.0 – 51.0 |
| | Jet A-1 | ASTM D 1655 | Kerosene | F-35 | –53 °F<br>–47 °C | 100 °F<br>38 °C | 37.0 – 51.0 |
| | Jet B | ASTM D 1655 | Wide-Cut | none | –72 °F<br>–58 °C | Below –4 °F<br>–20 °C | 45.0 – 57.0 |

5.2.1.1 JP-5 (NATO Code F-44). JP-5 is a kerosene fuel with an especially high flash point facilitating safety in shipboard handling. It is the only fuel that can be used for turbine engine aircraft aboard ships and is used widely at USN and USMC air stations. Because it has the highest density of all the aviation fuels, JP-5 has the greatest affinity for dirt, rust, and water contaminants.

5.2.1.2 JP-4 (NATO Code F-40). JP-4 is no longer widely used as a primary aviation turbine fuel by the U.S. military. It is used in a limited area (Alaska and some northern tier USAF bases) and may be encountered in other regions of the world (particularly Saudi Arabia and Canada). Jet B is the commercial equivalent of JP-4. JP-4 is a wide boiling range petroleum product including both gasoline and kerosene boiling range components. JP-4 exhibits better low temperature starting than JP-5. JP-4 fuel is intermediate between AVGAS and JP-5 with respect to its tendencies to acquire and hold dirt, rust, and water contaminants. It is an alternate fuel to JP-5 for USN and USMC jet aircraft. Both JP-4 and JP-5 fuels are procured under MIL-DTL-5624.

5.2.1.3 JP-8 (NATO Code F-34). JP-8, procured under MIL-T-83133, is a kerosene fuel similar to commercial jet fuel, ASTM Jet A-l, except that JP-8 contains the military additive package (see 5.2.2). It is also similar to JP-5 with respect to most fuel properties except flash point and freeze point. Since its flash point is not as high as JP-5 it cannot be used for shipboard operations. JP-8 is the primary aviation turbine fuel used at all Air Force and Army installations and by NATO.

5.2.2 Turbine fuel additives. Although JP-5 and JP-8 are quite similar to commercial turbine fuels Jet A and Jet A-1, and JP-4 is basically the same fuel as Jet B, there are some very important differences. In addition to small but significant differences in volatility, all three military fuels contain the following additives, which commercial jet fuels normally do not:

a. Fuel System Icing Inhibitor (FSII).
b. Lubricity Additive (corrosion inhibitor).
c. Antioxidants (storage stability additives).
d. Static Dissipator Additive (JP-4 and JP-8 fuels only).

5.2.2.1 Fuel System Icing Inhibitor (FSII). FSII is added to the fuel for two reasons: it provides icing protection and also acts as a biostat.

5.2.2.1.1 Icing protection. Even when the free-water content of the fuel is maintained below the 5 parts per million (ppm) level, FSII is essential because, in addition to free water, aviation fuel contains a significant amount of dissolved water. In general, the amount of dissolved water a fuel will hold in parts per million is approximately equal to the temperature of the fuel in degrees Fahrenheit. For example, a fuel that is 70 °F (21 °C) contains approximately 70 ppm dissolved water. If this fuel were cooled to 20 °F (-7 °C) it would then contain 50 ppm free water and 20 ppm dissolved water. When an aircraft is exposed to cold temperatures such as high altitudes or very cold weather conditions at sea level, the fuel contained in its tanks will drop in temperature allowing the water that is dissolved in the fuel to condense out into tiny droplets of free water. If the temperature of the fuel drops low enough (below 32 °F (0 °C)) these droplets will form ice crystals that will collect on screens or filters in the fuel system quickly blocking them. In addition, the ice crystals can cause fuel system valves to stick or malfunction preventing the aircraft pilot from using or distributing his fuel load.

5.2.2.1.1.1 Consequence of lack of FSII. The result of using fuel without sufficient FSII can be the loss of an aircraft. Certain aircraft are more susceptible to these problems than others because of differences in their fuel system designs as well as possible flight profiles. These aircraft are the S-3A, US-3A, and SH-60. Thus, these aircraft require a minimum FSII level of 0.03 percent by volume in their fuel. 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 any FSII.

5.2.2.1.2 Biostat. FSII prevents the growth of fungi and other microorganisms that can develop at the interface between the fuel and any water that collects at the bottom of the tank (aircraft as well as fuel storage). Since these microbiological growths can form rapidly, clog filters, and degrade the fuel, every effort should be made to maintain FSII levels as high as possible in order to maximize their biostatic effect. The best way of maintaining these levels is to minimize contact of the fuel with water, which tends to leach out the FSII from the fuel.

JP-5 (NATO Code F-44) tanks should, therefore, be stripped of water on a daily basis if any significant amount of water accumulates within a 24-hour period.

5.2.2.1.3 FSII materials. Diethylene Glycol Monomethyl Ether (DiEGME) (NATO Code S-1745) is the FSII used in U.S. military and NATO aviation turbine fuels. A similar commercial product, known by the trade name Prist, is approved for use in commercial aviation turbine fuels. The U.S. military specification that defines the properties of DiEGME and governs its procurement is MIL-DTL-85470. DiEGME is considered mutagenic in its neat state but is considered safe once blended into fuel. As a general rule, DiEGME is injected at either the refinery or Defense Fuel Supply Point (DFSP). Personnel involved in the handling and injection of FSII materials are advised to follow all instructions, wear appropriate personal protective equipment (gloves, aprons, and goggles at a minimum), and minimize their exposure as much as possible. Since FSII tends to become concentrated in the water that collects in the bottoms of fuel tanks (aircraft and storage) and filter/separator vessels, personnel handling these water bottoms are advised to follow similar precautions.

**Note**

**Shipboard addition of FSII is not authorized.**

5.2.2.2 Lubricity additive. A combination lubricity improver and corrosion inhibitor additive, procured under MIL-I-25017, is injected in all military turbine fuels at the refinery in order to improve the lubricating characteristics of the fuel. A series of several contiguous (one immediately following another) flights with fuel that does not contain one of these additives may cause abnormal wear or malfunctions of aircraft and/or engine fuel system components. A few flights (one or two) will not contribute to such problems since the additives tend to leave a protective coating on the components.

5.2.2.3 Antioxidant additives. These materials, which are injected into the fuel at the refinery, are particularly important for fuels that have been processed at the refinery with hydrogen. They ensure that the fuel will be stable when placed in long-term storage (a few months to several years). Commercial fuels do not need these additives since they are usually consumed within a few weeks to a couple of months. The first fuel property to drop below specification minimums in an unstable fuel is usually its thermal stability. Other properties such as total acid number, copper strip corrosion, and existent gums can also fall below acceptable minimums.

5.2.2.4 Static dissipator additive (SDA) (JP-4/ JP-8). JP-4 and JP-8 fuels are injected with a special additive that increases the fuel's conductivity and helps relax static electric charges, which are produced during fuel handling operations (filtration, pipeline movement, etc.). SDA, as this additive is now called, was originally added to these fuels to prevent small static initiated explosions that were occurring during refueling of polyester foam-filled USAF aircraft tanks. The USN and USMC have never experienced similar problems with foam-filled tanks (probably due to aircraft tank and refueling equipment design differences).

5.2.2.4.1 SDA and JP-5. Because SDA additives adversely affect the performance of shipboard centrifugal purifiers, SDA is not added to JP-5 (see 5.2.2.4.2.2 for the exception to this policy).

5.2.2.4.2 Conductivity. When USAF or foreign government aircraft are refueled with JP-4 or JP-8, the fuel should exhibit conductivity above 100 pS/m as measured by a portable conductivity meter, NSN 6630-01-115-2398, to protect the accuracy of certain sensitive aircraft fuel quantity gauging systems. Since SDA is depleted in the supply distribution system, USAF policy has been to add the additive as close as possible to the using activity or base. SDA is therefore most often added at Defense Fuel Support Points (DFSPs).

5.2.2.4.2.1 Testing conductivity at Navy/Marine Corps air activities. It is not necessary for Navy or Marine Corps activities to frequently test the conductivity levels of their stocks of JP-8 fuel when they are only refueling USN or USMC aircraft. However, occasional testing of the conductivity of these fuels is recommended in order to ensure that SDA is being injected at the proper level, especially since excessively high levels can affect the accuracy of certain aircraft gauging systems. If on such checks the fuel is found to be out of the specification conductivity range, the injecting facility (DFSP) should be informed immediately so that the injection rate can be adjusted accordingly. In some instances where the refueling of USAF aircraft is involved, manual addition of SDA at base level may be necessary in order to prevent aircraft damage. More information and assistance on this subject may be obtained from the Air Force Petroleum Office Technical Support Team located at Wright-Patterson Air Force Base, OH (DSN 785-4311 or commercial 937-255-4311).

5.2.2.4.2.2 When SDA should be added to JP-5. In a couple of special situations where very large numbers of USAF aircraft are frequently refueled it may be necessary to have the JP-5 supplied to a Navy/Marine Corps air activity injected with SDA. The above deterioration use limits are then applicable to JP-5.

5.3 Aviation gasoline.

5.3.1 General. Very little AVGAS is currently being used by the U.S. Military services. For this reason the AVGAS specified in MIL-G-5572, was canceled in 1988 and military needs are being satisfied via the commercial specification ASTM-D910.

5.3.2 AVGAS grades. AVGAS is graded according to its performance in a similar manner to the "octane" ratings used for automotive gasolines. "Performance Numbers," as they are called, are also based on the performance of the fuel in preventing engine knock, an extremely serious problem in aircraft engines due to the continuous high power demands placed upon them. The grades of AVGAS were formerly designated by 2 numbers; i.e., 100/130. The first number indicated the knock rating with a lean fuel-air mixture, while the second number indicated the knock rating with a rich fuel-air mixture. The new ASTM designations for these fuels now refer only to the lean knock rating. The different grades of AVGAS are dyed various colors so they can be easily distinguished. Table II shows the various grades of AVGAS and their colors.

5.3.3 Interchangeability. Grade 100 (high lead) and 100LL (low lead) have exactly the same performance characteristics and can be used interchangeably. Grade 100 and Grade 100LL may also be commingled in storage tanks at air stations. Note that if these two fuels are mixed an unusual color may result. Grade 80 is a very low lead fuel with a lower performance rating. The very high performance fuel, 115/145, has almost completely disappeared and aircraft that needed this fuel have been modified to accept 100LL.

5.3.4 AVGAS and fuel contaminants. Since AVGAS is the lightest (lowest density) naval aviation fuel, it has the least tendency to acquire and hold in solution dirt, rust, and water contaminants making it the easiest aviation fuel to keep clean.

5.3.5 Tetraethyl lead. All AVGAS contains some tetraethyl lead for the improvement of its anti-knock performance. The presence of this fuel additive makes it very deleterious to turbine engines so it is extremely important that turbine fuels not be contaminated with even small amounts of AVGAS.

TABLE II. Grades of aviation gasoline

| ASTM-D910 | MIL-G-5572 | Color | NATO Symbol |
|---|---|---|---|
| Grade 80 | 80/87 | Red | ----- |
| Grade 100 | 100/130 | Green | ----- |
| Grade 100LL | 100/130 Low Lead | Blue | F-18 |
| No equivalent | 115/145 | Purple | ----- |

# 6. CONTAMINATION OF AIRCRAFT FUELS

## 6.1 General.

6.1.1 Requirement for quality surveillance of aviation fuel. Basic information and minimum requirements pertaining to the quality surveillance of aviation fuels at Navy and Marine Corps air activities are contained in Chapters 3 and 9 of the NATOPS Aircraft Refueling Manual, NAVAIR 00-80T-109. This chapter provides a brief review of these requirements with amplifying information.

6.1.2 Objective. The major objective of fuel handling personnel is to deliver clean, water-free, and correct fuel to aircraft. The fuel systems of modern aircraft are complex and will not function properly if fuel is contaminated with dirt, water, or other foreign matter. Foreign matter in fuel can plug or restrict fuel pumping and metering equipment and accelerate the clogging of fuel filters. Fuel contaminated with water is harmful because ice may be formed at high altitudes also clogging aircraft components. The presence of water also permits the growth of microorganisms in aircraft fuel tanks, which hinder the operation of components and cause corrosion in fuel systems.

6.1.3 Engine problems due to fuel contamination or incorrect fuel. Aircraft engine failure or poor performance may also be caused by incorrect fuel or by contamination of the proper fuel with other petroleum products. For example, a small amount of turbine engine fuel in aviation gasoline can significantly reduce its anti-knock quality. Similarly diesel fuel, lubricating oils, and hydraulic fluids are harmful to the quality of both types of aviation fuels. Any contamination of aviation fuels is to be avoided.

6.1.4 "Clear" and "Bright". As a general rule, for aviation fuel to be acceptable to aircraft it should be clear, bright, and contain no free water. The terms "clear" and "bright" are independent of the natural color of the fuel. The various grades of AVGAS have dyes added. Turbine fuels are not dyed and may be any color from water-white to straw yellow. "Clear" means the absence of any cloud, emulsion, readily visible particulate matter, or entrained water. "Bright" refers to the shiny appearance of clean, dry fuels. A cloud, haze, specks of particulate matter, or entrained water indicates that the fuel is unsuitable and points to a breakdown in fuel handling equipment or procedures.

## 6.2 Types and sources of contamination.

6.2.1 General. Aircraft fuel can be contaminated with particulate matter, free water, foreign chemicals, microorganisms, or any combination of the four. In addition to the following paragraphs that discuss these various types of contamination, Appendix A is a guide to help in the detection and understanding of the consequences of the various types of contamination. In practice, any significant (deleterious) amount of coarse material contaminant can usually be detected visually.

6.2.2 Particulate matter. Particulate matter appears as dust, powder, grains, flakes, fibers, or stain. Particulate matter, or solid contamination, can be separated into two categories — coarse matter and fine matter.

6.2.2.1 Coarse matter. Coarse matter can be seen and easily settles out of fuel or can be removed by adequate filtration. Ordinarily, particles 10 microns in size and larger are regarded as coarse matter (a micron is 1/1,000,000th of a meter or approximately 1/25,000th of an inch). Figure 1 illustrates just how small these particles can be. Coarse particles clog orifices and wedge in sliding valve clearances and shoulders, causing malfunctions of fuel controls and metering equipment. They are also effective in clogging nozzle screens and other fine screens throughout the aircraft fuel system.

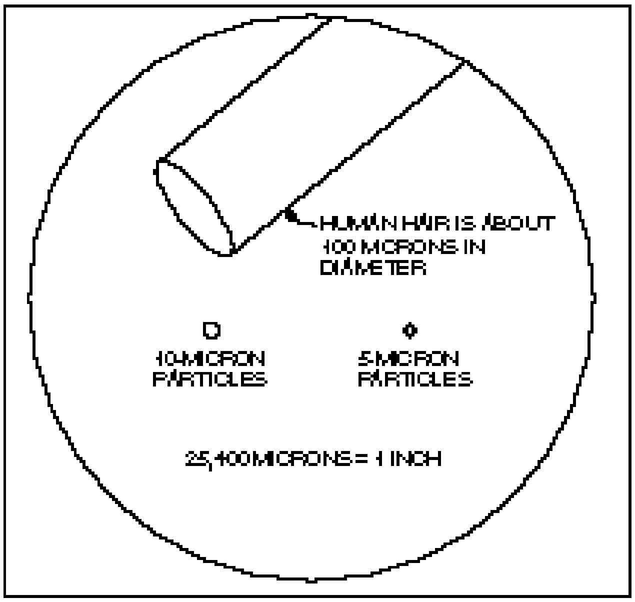



FIGURE 1. Enlargement of small particles and comparison to human hair

6.2.2.2 Fine matter. Fine matter are particles smaller than 10 microns. To a limited degree, fine matter can be removed by settling, filtration, and the use of centrifugal purifiers. Particles in this range accumulate throughout fuel controls, appearing as a dark shellac-like surface on sliding valves, and may also be settled out in rotating chambers as sludge-like matter, causing sluggish operation of fuel metering equipment. Fine particles are not visible to the naked eye as distinct or separate particles; they will, however, scatter light and may appear as point flashes of light or a slight haze in fuel. Occasionally a fuel contaminated with gross amounts of fine particulate matter that does not respond to normal filtration and cleanup procedures may be encountered. For shipboard applications notify TYCOM (see Appendix D) or higher authority for guidance. It may be necessary to install special 2-micron filters in order to bring such a fuel within deterioration use limits.

6.2.2.3 Most prevalent particulate contamination. The most prevalent types of particulate matter contamination in aircraft fuels are iron rust and scale, sand, and airborne dirt. The principal source of iron rust and scale is the corrosion in pipelines, storage tanks, and other fuel containers. Sand and dirt are particularly serious in extremely sandy or dusty areas.

6.2.2.4 Experience reducing the level of particulate contamination. Experience has shown that solid contaminants (rust and dirt) can be held well below a level of 1 milligram per liter (mg/liter) in a properly functioning fuel distribution system. If solid contaminants in fuel at aircraft dispensing points exceed 1 mg/liter when measured by the Contaminated Fuel Detector (CFD), or by laboratory analysis using ASTM-D2276, investigative and corrective action should be taken to improve fuel quality. If solid contaminants exceed 2 mg/liter, delivery of fuel to aircraft should be stopped and corrective measures completed prior to resumption of fueling operations.

6.2.2.5 Hose talc. Hose talc can be a source of fuel contamination with some older types of hoses (especially collapsible hose). Talc (soapstone) material, which is applied to the interior of the hose by the manufacturer to aid the curing process, can be dislodged during normal handling and reeling operations. Prolonged soaking in fuel also tends to loosen talc. Fueling stations subjected to a reduced level of activity are particularly prone to talc contamination. Although hose pickling is designed to prevent this type of contamination it is not always successful in doing so. Hoses manufactured to API 1529/NFPA 407 do not have a talc problem and do not need to be pickled.

6.2.3 Water. Free water (undissolved water) is a common contaminant of fuels and refueling personnel should be concerned with it in two forms: 1) entrained in the fuel, and 2) as a separate phase (liquid water). Entrained water is found in fuels in the form of very small droplets, fog, or mist and it may or may not be visible. When large quantities of entrained water are present, the fuel will have a hazy or milky appearance. Water usually becomes entrained in the fuel when it is broken up into small droplets and thoroughly mixed with the fuel in equipment such as pumps or meters. Given sufficient time and the proper conditions, entrained water will settle and separate from aviation gasoline; however, since they are fairly dense compared to AVGAS or motor gasoline, turbine engine fuels will hold entrained water in suspension for long periods of time. Once separated and settled from the fuel, water will collect at the bottoms of tanks, pipes, and other fuel system components.

6.2.3.1 Dissolved water. Fuel will actually dissolve a small amount of water. Dissolved water is absorbed into the fuel and is not visible. The amount a fuel will hold in a dissolved state is dependent upon the fuel’s temperature. A rough correlation can be made between a fuel’s temperature in degrees Fahrenheit and the amount of water that can be dissolved in it. For example, a fuel at 60 °F (15.5 °C) will hold approximately 60 parts per million (ppm) dissolved water, while at 30 °F (-1 °C) it will hold only 30 ppm. It is important to note that as a fuel cools down, the water dissolved in it at the higher temperature will come out of solution and become free water.

6.2.3.2 Free water. Free water may be fresh or saline. Free water may be in the form of a cloud, emulsion, entrained 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 components. A fuel system icing inhibitor (FSII) 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 preferentially soluble in water, prevention and elimination of water from fuel transportation and storage systems are essential. Failure to eliminate water could result in the loss of FSII below an acceptable use limit.

6.2.3.2.1 Detrimental effect of free water. Free water (water dispersed as a haze, cloud, or droplets) in fuel can be disastrous in aircraft fuel systems — particularly sea water. It can cause filter and fuel control icing, fuel quantity probe fouling, and corrosion of fuel system components. Water is also the one item essential for microbiological growth to develop in aircraft tanks.

6.2.3.2.2 Free water allowable limit. The maximum allowable limit of free water in fuel at aircraft dispensing points is 5 ppm when tested by the free water detector. A satisfactorily performing filter/separator will provide fuel containing less than 5 ppm of free water. Should the level of free water in fuel at an aircraft dispensing point exceed 5 ppm, a second sample will be taken immediately to ascertain if the second sample confirms that the free water exceeds 5 ppm. If so, fueling will be stopped until changes in procedure and equipment reduce the free water to 5 ppm or below.

**Note**

API-1581 allows 15 ppm of free water in the effluent fuel of a filter-separator vessel being tested using the API-1581 test procedure. This high free water limit is necessary because of the large quantities of free water introduced during API-1581 qualification (and acceptance) testing of filter-separator vessels. Facilities with fuel distribution systems which contain filter-separator vessels certified to API-1581 should be aware that the 15 ppm free water limit is not applicable to in-service API-1581 filter-separator vessels. All properly functioning filter-separator vessels are capable of providing aviation jet fuel having less than 5 ppm of free water (as measured by the free water detector or Aqua-glo instruments).

6.2.4 Chemical contamination. Chemical contamination usually results from the inadvertent mixing of petroleum products. This type of contamination affects the chemical and physical properties of the fuel and can generally be detected only by specific laboratory tests. These tests are conducted at refineries, bulk terminals, and petroleum testing laboratories. Chemical contamination is prevented by isolating fuels and providing separate handling systems. Pilots and personnel servicing aircraft will seldom be confronted with chemical or petroleum contamination and will be able to detect contamination only by an unusual color, appearance, or odor.

6.2.4.1 Determining chemical contamination. When doubts as to fuel quality cannot be resolved by application of the standard fleet test methods, fuel samples should be drawn and shipped immediately to at least one of the petroleum testing laboratories listed in Appendix B.

6.2.4.2 Sources of chemical contamination. During transportation by truck, railroad, barge, tanker, or fleet oiler and during terminal or station storage there are frequent opportunities for contamination with other bulk petroleum products. In some instances it is not feasible to completely eliminate the possibility of some contamination. The use limits for fuel chemical and physical properties specified in Appendix B of the Aircraft NATOPS Refueling Manual should not be used to determine the acceptability of fuels from a commercial contractor. The procurement specification should be adhered to in determining acceptability of products from contractors. If the product no longer meets the procurement specification but conforms to the chemical and physical property limits specified in Aircraft Refueling NATOPS Manual, Appendix B, a request for waiver will be submitted to the Naval Operational Logistics Support Center DC (NOLSC-DC) (see table B-I for address) together with pertinent facts concerning the circumstances and nature of the contamination. It is important to stress that the prescribed use limits are designed to serve as parameters in determining the quality of fuel in storage and not as procurement criteria. Known contamination with other products should be limited to the percentages shown in table III.

TABLE III. Allowable contamination with other products

| | | Product Being Handled | | | |
|---|---|---|---|---|---|
| | | 80/87 | 100LL 100/130 | JP-4 | JP-5 |
| Contaminating Product | 80/87 | N/A | 0.5% | 5.0% | 0.0 |
| | 100LL; 100/130 | 5.0% | N/A | 1.0% | 0.0 |
| | JP-4 | 0.5% | 0.5% | N/A | 0.0 |
| | JP-5 | 0.5% | 0.5% | 10.0% | N/A |
| | Diesel | 0.5% | 0.5% | 0.5% | 0.5% |
| | Naval Distillate | 0.5% | 0.5% | 0.5% | 0.5% |

6.2.4.3 Mixing of different grades of fuel. The mixing of different grades or types of fuels is inexcusable and results from the careless operation of the fuel handling equipment and facilities. It is considered a sign of poor performance, poor management, and inattention to aviation safety by refueling personnel. All personnel should know and remember that small quantities of one fuel can seriously contaminate and render unusable another aircraft fuel. For example, the alternate use of a truck-mounted refueler for turbine fuel and aviation gasoline can contaminate aviation gasoline sufficiently to cause failure of an engine designed for high-octane aviation gasoline.

6.2.5 Microbiological growth. Microbiological growth consists of living organisms that grow at the fuel-water interface. Fungus is the major source responsible for problems associated with microbiological contamination of jet fuels. Fungus is a form of plant life; it holds rust and water in suspension and acts as a stabilizing agent for fuel-water-sediment emulsion. It clings to glass and metal surfaces and can cause erroneous readings in fuel quantity gauging systems, sluggish fuel control operation, and sticking of flow dividers.

6.2.5.1 Location of microbiological growth. Microbiological growth is generally found wherever pockets of water exist in fuel tanks. Microorganism contamination appears as a brown slime-like deposit that adheres to the inner surfaces of fuel tanks. Although bacteria and fungi are present in most turbine fuels, the conditions necessary for their growth include water, fuel, and trace minerals. Water remains the key ingredient. Without free water there is no growth.

6.2.5.2 Prevention of microbiological growth. The presence of microbiological growth in fuel being delivered to aircraft is a reliable indication of the presence of free water and the failure of fuel cleanup equipment. FSII in sufficient concentrations in the water bottoms of aircraft fuel tanks prevents the growth of microorganisms; however, this does not alleviate the requirement for the daily removal of all water from the low point drains since this action is necessary to prevent corrosion and the deterioration of tank coatings. The growth of microorganisms and their resultant contamination is usually most severe in tropical climates where temperature and humidity are high.

6.3 Common sources of contamination. Some of the most common sources of contamination of fuel supplies are:

a. Fuel storage tanks containing water bottoms that cannot be completely drained.

b. Floating roof tanks that allow the entry of rainwater and airborne dust.

c. Pipeline water slugs used to separate products.

d. Water introduced by ballasting or leaks during transport in tanks, tankers, or barges.

e. Previously contaminated fuel being defueled from aircraft into storage tanks.

6.4 Procedures for preventing contamination.

6.4.1 General. Contamination of aircraft fuel can be prevented only by the use of proper equipment and by following proper operating procedures. “Retail” or “Ready Issue” fuel handling systems are to be used at all shore station aircraft refueling activities to contain and process the fuel immediately prior to issue to aircraft. These systems include an approximate 10-day supply (based on normal base issues to aircraft) of storage capacity. Storage tanks used in this system should have sloping bottoms, bottom suction (pick-up), and continuous recirculation through a filter/separator that removes both water and particulates. Additional filter/separators further clean and dry the fuel as it is loaded onto trucks at truck fill stands or as it enters and/or exits direct refueling or hydrant systems. Special fuel quality monitors that will actually shut off the flow of fuel if they are exposed to excessive water or particulates are used in conjunction with filter/separators at truck fill stands, on trucks and hydrant hose carts, and at direct refueling stations. Proper care and operation of these systems will help ensure that only clean dry fuel enters aircraft.

6.4.2 Problem prevention and detection. Even though retail fuel delivery systems are designed with multiple filtration steps, the success of these systems is dependent upon the manner in which they are operated and maintained. The pressure drops across filter/separators and monitors should be routinely observed and recorded in order to detect failures or problems. In addition, every precaution should be taken to prevent the introduction of any particulate matter, such as dirt into the fuel. All openings and connections, including refueling nozzles, should have dust-tight caps or covers that remain in place at all times except when in use.

6.4.3 Vigilance in fuel delivery operations. The mixing of fuels or the delivery of the wrong fuel can be avoided only by alert and careful personnel who know and follow the proper procedures. Accidents caused by fuel mixing are solely the responsibility of fuel handling personnel. Fortunately most Navy and Marine Corps air facilities handle only one aviation fuel, aviation turbine fuel, JP-5 (F-44) or JP-8 (F-34). While this situation helps to minimize the problem, it does not reduce the need for vigilance. Where more than one type or grade of aviation fuel are handled, completely separate handling facilities and equipment for each type and grade of fuel are essential in preventing contamination.

6.5 Deterioration of aircraft fuels. The following are some of the most frequently encountered situations in which some form of contamination leads to deterioration of an aircraft fuel.

6.5.1 Aviation turbine fuel.

a. Reduction in Flash Point (JP-5 and JP-8). The flash points of these fuels will be reduced when contaminated with other fuels having lower flash points.

b. Contamination with Dirt, Rust, and Water. This is due to normal handling procedures. JP-5 and JP-8 have a greater affinity for these contaminants than AVGAS or JP-4; therefore contaminant removal is more difficult. If adequate surveillance is not practiced, contamination is almost certain to result.

c. Contamination with Naval Distillate Fuel (F-76). This is a shipboard handling problem. Naval distillate in amounts of 0.5 percent or more may inactivate filter/separators.

6.5.2 Aviation gasoline

a. Lowering of Vapor Pressure. The change in this property is usually due to prolonged storage in vented tanks in warm climates.

b. Loss of a Fuel’s Performance Rating. The performance rating of a fuel will usually be degraded as a result of contamination with another petroleum product.

c. Increase in Copper Corrosion. The corrosive properties of AVGAS often increase as a result of storage in warm climates in tanks with water bottoms or sludge accumulations. Bacteria growing in the water bottoms and/or sludge generate hydrogen sulfide, which dissolves in the fuel.

d. Contamination with Dirt, Rust, and Water. These types of contamination are due to normal handling and are not difficult to remove, utilizing settling or filtration methods.

6.6 Sampling of aviation fuel. Detailed information on sampling practices and techniques is specified in ASTM-D4057 (see 2.3). All activities that handle aviation fuel should have a copy of this document. It is available directly from ASTM:

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
Telephone: 610-832-9585
Telefax: 610-832-9555
Online: http://www.astm.org

This document is also available from:

Standardization Documents Order Desk
Bldg. 4D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Online: http://www.dodssp.daps.mil

# 7. FLEET QUALITY SURVEILLANCE TESTS

7.1 General. Fleet activities should monitor the fuel they issue to aircraft for particulate and free-water contamination and FSII content. In some special situations it may also be necessary for activities to monitor the conductivity of their fuel. This chapter describes the test equipment and general procedures used to monitor these fuel properties.

7.2 Particulate contamination.

7.2.1 Contaminated fuel detector(CFD). The CFD, sometimes referred to as the "AEL Mk III," procured under MIL-D-22612, is a portable unit for use in the field and aboard ship to determine the solid contamination existent in aviation fuels. The instrument has a range of 0 to 10 mg/liter of solids. The only versions of this detector available is the Combined Contaminated Fuel Detector (CCFD), NSN 6640-01-013-5279, which includes a built-in Free Water Detector (FWD) Viewer Kit.

7.2.1.1 Capability of CCFD. This unit provides operating activities with a capability to determine the solids content of aviation fuels. While the unit is comparatively simple to use, it is a precision instrument and should be treated accordingly. The maximum value of this unit can best be realized by placing it in the hands of the person responsible for quality control and inspection of aviation fuels for the activity.

7.2.1.2 Accuracy of CCFD. The accuracy and value of a unit of this nature will depend upon the personnel operating it. If the results are to be valid, the fuel samples should be truly representative and the whole operation conducted so that nothing extraneous is introduced. Normally it will be easier to bring the fuel sample to the instrument than the instrument to the fuel.

7.2.1.3 Calibration of CCFD and correlation with gravimetric method. It should be recognized that this instrument is only a secondary standard that supplements laboratory analysis and does not replace the requirements for periodic laboratory gravimetric analysis. Extensive field tests have demonstrated that the calibration curve furnished with this unit is valid for the majority of fuel samples, but there are occasional samples that do not fit the normal pattern. It may become necessary to establish a new or modified calibration curve 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 will give a cross check on the instrument and quickly pinpoint these unusual systems. In addition, CFD operators are requested to visually inspect the Millipore filter pads for any large particles or unusual spots and stains that may cause erratic or erroneous CFD results. Any such situations that frequently reoccur should be reported to the Naval Air Systems Command (AIR-4.4.5) at the following address:

Commander
Naval Air Systems Command
AIR-4.4.5, Bldg. 2360
22229 Elmer Rd., Unit 4
Patuxent River, MD 20670-1906

Telephone Numbers:
DSN — 757-3405/3409/3410
Commercial — 301-757-3405/3409/3410

Telefax Numbers:
DSN — 757-3614
Commercial — 301-757-3614

Message Address:
COMNAVAIRSYSCOM PATUXENT RIVER MD//4.4.5//

7.2.2 CFD test technique. A sample of fuel to be tested is obtained in the sample bottle provided. This fuel is filtered through two membrane filters (NSN 1H 6630-00-877-3157) placed in series. The solid contaminants will be collected on the top filter. A light is shown through each filter and a meter measures the decrease in transparency of the filters due to the trapped solids. Use of two filters eliminates errors due to variations in color of different fuels. A calibration chart is provided to convert the meter readings to contamination levels in mg/liter. The special filters used to calibrate the unit are available from the Navy Ships Parts Control Center, Mechanicsburg, Pennsylvania, under NSN 1H 6630-00-849-5288.

7.2.3 CFD operating procedure. Complete details on the operation of the detector are contained in the technical manual supplied with each detector. The following procedure applies to all CFDs in general, and may be used in the event the manual is unavailable.

a. Turn the detector on and allow it to warm up for 2 to 3 minutes.

b. Ensure the vacuum-receiving flask is empty and the drain cock closed.

c. Place two membrane filters, one on top of the other, in the bottle receiver.

**Note**

The membrane filters are packaged with blue paper between the filters. Dispose of the blue paper dividers. Do not use them for filtration.

d. Fill the sample bottle provided with 800 milliliters of fuel to be tested. Fit the bottle receiver onto the top of the sample bottle. Plug the grounding wire from the bottle receiver into the receptacle provided on the CFD.

e. Turn the vacuum pump on. Holding the bottle receiver snug against the sample bottle, invert the assembly and fit the bottle receiver into the top of the vacuum flask.

f. Gently swirl the fuel in the sample bottle while the fuel is being filtered to ensure any contaminants are washed down with the fuel through the filters. The movement of the bottle should also be sufficient to vent the bottle, allowing air bubbles into the bottle.

g. When all of the fuel has passed through the filters, turn the pump off, and remove the sample bottle from the bottle receiver.

h. Drain the fuel from the vacuum receiving flask into an appropriate container for disposal.

i. With no filter in the tray, and the tray fully inserted, adjust the panel meter to a reading of 600 milliamperes.

j. Place a small amount of pre-filtered fuel in the wetting dish depression provided on the top of the detector. Open the bottle receiver and remove the top membrane filter with forceps. Gently lay the filter in the wetting dish so that the entire filter is wetted with fuel.

k. Place the wetted filter into the filter tray, insert the tray into the photocell housing, and record the milliammeter reading. Remove the filter from the tray.

l. Confirm the meter still reads 600 milliamperes with no filter in place. Repeat the wetting process with the second membrane filter, and place it in the filter tray. Insert the tray in the photocell housing and record the milliammeter reading. Remove the filter from the tray and dispose of both filters.

m. Subtract the lower of the milliammeter readings from the higher allocated set. Locate the change in reading value on the vertical left axis of the calibration chart, and read the corresponding value of contamination (where the change in reading intersects the curve) in milligrams per liter from the horizontal bottom axis of the chart. Report the contamination in milligrams per liter.

**Note**

Detailed instructions or assistance in operating or calibrating a specific model detector are available from Naval Air Systems Command AIR-4.4.5 (see 7.2.1.3).

7.2.4 Alternate methods. An alternate system for the field detection of particulate contaminants in aviation fuel, which is approved for use at shore facilities only, is the USAF's system of in-line sampling coupled with a visual assessment technique. Details on this method and the necessary equipment can be obtained from USAF Technical Order 42B-1-1, Quality Control of Fuels and Lubricants, 5-7. Copies of this document are available from the Naval Air Systems Command, AIR-4.4.5 (see 7.2.1.3). Another version of this visual particulate testing technique that is also approved for use at shore activities is contained in the U.S. Army's Aviation Fuel Test Kit.

7.3 Water contamination.

7.3.1 General. The viewer kit, Free Water Detector procured under MIL-D-81227, NSN 6640-00-999-2786, is a simple, small unit for use in the field or the laboratory to determine the free-water content of aviation fuels. It was designed for use in conjunction with the CFD and will accurately measure undissolved water in jet fuels. The current version of this device is sometimes referred to as "AEL Mk II," while an earlier version was designated "AEL Mk I." CCFDs now in use include free-water detector capability and may be used instead of a separate FWD.

7.3.2 FWD test technique. A sample of fuel to be tested is passed through a chemically treated filter pad (NSN 9L 6640-00-999-2785) by using the filter holder and vacuum pump of the CFD or CCFD. The chemical on the pad is sensitive to any free water in the fuel, producing a fluorescent pattern readily visible under ultra-violet light. After filtration, the pad is examined under the ultra-violet light contained in the FWD or CCFD. The amount of free water in the fuel sample is determined by the intensity of fluorescence on the test pad. Visual comparison is made with a series of standards representing known quantities of water. Standards, which are available under NSN 9L 6640-00-999-2784, tend to deteriorate with time and exposure to ultra-violet light. They should, therefore, be replaced every 6 months.

7.3.3 FWD operating procedure.

a. Turn the detector on and allow it to warm up for 2 to 3 minutes.

b. Ensure the vacuum receiving flask is empty and the drain cock closed.

c. Place the 47-mm free-water pad into the bottle receiver.

d. Fill the sample bottle provided with 500 milliliters of fuel to be tested. Shake the sample vigorously for approximately 30 seconds. Fit the bottle receiver onto the top of the sample bottle. Plug the grounding wire from the bottle receiver into the receptacle provided.

e. Turn the vacuum pump on. Holding the bottle receiver snug against the sample bottle, invert the assembly and fit the bottle receiver into the top of the vacuum flask.

f. Gently swirl the fuel in the sample bottle while the fuel is being filtered to ensure any contaminants are washed down with the fuel through the filters. The movement of the bottle should also be sufficient to vent the bottle, allowing air bubbles into the bottle.

g. When all of the fuel has passed through the filters, turn the pump off, and remove the sample bottle from the bottle receiver.

h. Drain the fuel from the vacuum receiving flask into an appropriate container for disposal.

i. Remove the free-water pad from the bottle receiver and place in the free-water detector slide. Insert the slide into the free-water detector and turn on the ultra-violet light.

j. Visually compare the fluorescence on the free-water pad with that on the free-water standards inside the detector. The free-water standards provided show the fluorescence at 0, 5, 10, and 20 parts per million (ppm) of free water. Estimate the corresponding free-water content by fluorescence intensity and droplet pattern on the free-water pad.

**Note**

If the result is greater than 20 ppm, take a new sample half the volume of the original (250 ml), read the fluorescence, and double the value.

k. Report the free-water results in parts per million.

**Note**

The free-water test utilizing the FWD should be executed as soon as possible following sampling since the results are directly affected by any temperature change in the fuel sample. This test, conducted by the sampling activity, is the only free-water determination now required and is more accurate than can be obtained from a sample sent to a laboratory.

7.3.4 Alternate Method. The Aqua Glo Water Detector (ASTM-D3240) is an approved alternate instrument for determining the free-water content of aviation fuels using 25-mm pads. This instrument is included in the US Army Aviation Fuel Test Kit.

7.4 Fuel System Icing Inhibitor (FSII) content.

7.4.1 General. The B/2 Anti-Icing Additive Refractometer and Test Kit (NSN 6630-01-165-7133) provides a simple and accurate means of determining the FSII content of aviation fuels.

7.4.2 B/2 test technique. A sample of fuel to be tested is placed in a separatory funnel along with a small quantity of tap water. After agitation, a few drops of the water layer are placed on the cell of the refractometer and a reading is taken directly from the appropriate scale. During this process the FSII is “washed” from the fuel and collects in the water layer. Since the FSII content of the water changes its refractive index, the extent of this change is used to determine the concentration of FSII in the fuel.

7.4.3 B/2 operating procedures. Detailed instructions are provided with the test kit. The following procedure summarizes the operation of the kit.

a. Procure 1 pint (473 milliliters) of fuel to be tested in a clean and dry container.

b. Assemble the ring stand. Fill an aluminum dish one half full of water. Tap water can be used.

c. Pre-treat the graduated cylinder and separatory funnel with the test fuel. Place a small amount of fuel in the cylinder, swirl to wet the sides of the cylinder, then pour out the fuel. With the drain cock closed, place a small amount of fuel in the separatory funnel and swirl to wet the sides of the funnel. Pour the fuel out of the top of the funnel; do not use the drain cock for this step.

d. Transfer exactly 160 milliliters of the fuel from step 1 to the separatory funnel. Some kits may have a separatory funnel with a line marking the 160-milliliter capacity instead of a graduated cylinder. Fill to that line if the kit is so equipped.

e. Using one of the piston pipettes contained in the set, add exactly 2 milliliters of water to the separatory funnel from the aluminum dish supply. Cap the funnel and shake vigorously for 3 minutes. Swirl funnel and place in ring stand.

f. Open the cover of the refractometer's window and make sure that it is clean. Apply several drops of water to it from the aluminum dish supply. Close the cover and observe through the eyepiece the location of the shadow in the viewer. Remove the plastic rod from the instrument's base and adjust the setscrew in the base if necessary, so that the shadow line intersects the zero line of the scale. Clean and cover the refractometer's window.

g. Carefully rotate the separatory funnel's drain cock so that a trickle of fluid can be obtained in a clean, dry aluminum dish. Use two to three drops.

h. Using the same technique as step f, transfer the fluid from the aluminum dish to the refractometer's window. Close the cover and observe the position of the shadow line. If testing JP-5 with DiEGME, read the scale on the left. If testing JP-4 with EGME, read the scale on the right. Record results.

i. Properly dispose of the fluids. Wash the apparatus in soap and water and properly dry all items. Treat the refractometer as an optical instrument and avoid damage to the lens and window elements.

7.5 Conductivity.

7.5.1 General. The EMCEE Fuel Conductivity Meter (NSN 6630-01-115-2398) provides a simple method of measuring the electrical conductivity of aviation turbine fuels with SDA injected in them.

7.5.2 Fuel conductivity meter test procedure. A sample of the fuel to be tested is extracted into a sampling bottle or can. The meter's probe is inserted into the fuel sample and its conductivity is read directly from the meter. Detailed instructions for the calibration and use of this meter are available in USAF Technical Order 42B-1-1, Quality Control of Fuels and Lubricants, paragraph 5-14, copies of which are available from the Naval Air Systems Command, AIR-4.4.5 (see 7.2.1.3).

# 8 SAFETY IN FUEL HANDLING OPERATIONS

## 8.1 Introduction.

8.1.1 General. This chapter identifies and explains the more hazardous elements of aviation fuel handling with particular emphasis on electrostatic phenomena and their effects on fuel operations. The better these hazards are known and understood by refueling personnel, the better refueling personnel will be at avoiding or correcting unsafe situations.

8.1.2 Continuous development of safe procedures. The development of safe and efficient fuel handling and aircraft refueling procedures is a continuously evolving process. Scientific investigations are coupled with actual field experience in order to establish the safest and simplest procedures possible. One of our most important sources of information in this process often is the investigation of field accidents or problems. It is therefore extremely important that knowledgeable personnel are involved in accident investigations especially whenever explosions or fires have occurred. This section is designed to provide a basic education on the subject of the hazards of fuel handling; however, it is advisable to request the assistance and participation of experts whenever major fuels accidents are being investigated to ensure that correct conclusions are drawn. NAVAIR (AIR-4.4.5) and NOLSC-DC will assist in the identification of appropriate experts for any investigation.

## 8.2 Abnormal fuel operations.

Do not depart from the requirements and operating procedures contained in the NATOPS Aircraft Refueling Manual, NAVAIR 00-80T-109, or of the activity fuel instruction without the full cognizance of the FMO. When in doubt, operators should contact the FMO. Furthermore, fuel operators should discontinue any fuel operation that does not appear to be progressing in a normal fashion (such as appearing to be taking much longer than would normally be expected, pressures are too high, etc.) and immediately notify the FMO of their apprehensions. This is not to say that a special or one-time operation should not be conducted, but rather that it should be closely monitored and performed under the surveillance of the most knowledgeable fuel personnel available.

## 8.3 Fire and explosion.

8.3.1 General. Three factors are necessary for combustion of fuel — fuel in the form of vapor, oxygen from the air, and sufficient heat to raise a material to the ignition temperature. These three factors should all be present to produce a fire. The removal of any one of the factors will prevent combustion. All refueling or defueling operations contain two essential factors , fuel and air, therefore the elimination of sources of ignition is the most effective way of preventing fire. Reducing or controlling the generation of fuel vapor is extremely important in preventing fires and explosions. See the NATOPS manual for specific procedures that reduce the generation of fuel vapor.

8.3.2 Flammable fuel-air mixtures. The probability of a fuel vapor-air mixture being flammable is dependent on the vapor pressure and flash point of the product. Table IV provides Reid vapor pressures for aviation fuels. These properties may be used to classify refined products into low, intermediate and high vapor pressure categories.

8.3.2.1 Low vapor pressure products. Low vapor pressure products such as, JP-5, JP-8, commercial Jet A, diesel fuel, kerosene, furnace oil, safety solvents, etc., usually have flash points above 100 °F (38 °C). Since these products are normally handled at temperatures well below their flash points, no hazard is involved because no flammable vapors will develop. However, conditions for ignition may exist if these products are handled at temperatures above their flash points, if they are mixed with intermediate or high vapor pressure products, are loaded into tanks where flammable vapor may be present from previous usage (switch loading), or are splash loaded.

TABLE IV. Vapor pressures of aviation fuels

| VAPOR PRESSURE CATEGORY | FUEL TYPE | FUEL GRADES | NATO CODE | VAPOR PRESSURE,psi (kPa) | |
|---|---|---|---|---|---|
| | | | | MINIMUM | MAXIMUM |
| High | AVGAS | 100LL (100, 80/87, 100/130, 115/145) | F-18 | 5.5 (38.5) | 7.0 (49.0) |
| Intermediate | Wide-Cut Turbine Fuel | JP-4 (Jet B) | F-40 | 2.0 (14) | 3.0 (21) |
| Low | Kerosene Turbine Fuel | JP-8 (Jet A-1, Jet A) | F-34 | 0.0 | 1/ 0.1 (0.7) |
| Low | High Flash Kerosene Turbine Fuel | JP-5 | F-44 | 0.0 | 0.035 1/ (0.245) |

1/ These are approximate values. The vapor pressure of kerosene fuels is indirectly limited by the flash point.

8.3.2.2 Intermediate vapor pressure products. These materials may create flammable mixtures in the vapor space at some normal handling temperatures. Examples of these products are JP-4, commercial Jet B, and solvents such as xylene, benzene, and toluene.

8.3.2.3 High vapor pressure products. These products are so volatile that under equilibrium conditions at normal handling temperatures, between 2 °C and 38 °C (35 °F and 100 °F), they produce a "too rich" mixture to be flammable in a restricted vapor space. When high vapor pressure products are loaded into gas-free tanks, the vapor space will pass through the flammable range, but vapor just above the surface becomes over-rich almost immediately. In this and other tank filling operations, it is possible that a stratified layer of flammable vapor will be raised to the top of the tank by the filling process. Products that do not create flammable vapor mixtures in the normal handling temperature range could do so under extreme temperature conditions.

Figure 2, which shows the approximate correlation of Reid vapor pressure (Rvp) and product temperature to the flammable range, may be useful in determining whether a flammable vapor-air mixture is likely to exist. The above information is important to understand from the safety standpoint, but in actual practice individual flammability determinations will not be made by operators. All fuel handling operations, regardless of the product, are conducted in accordance with established procedures that are designed for the most hazardous product or combination thereof.

8.3.2.4 Mixing different grades of aviation turbine fuel. The mixing of different grades of aviation turbine fuels in ground handling operations is held to the minimum level practicable; however, all fuel defueled (removed) from aircraft is almost invariably a mixture of grades. For this reason defueled fuel should be handled as a separate grade of fuel designated “JP” or “jet fuel” and not “JP-5,” “JP-8,” “JP-4,” or the equivalent analogous NATO Code Number until laboratory testing determines actual grade.

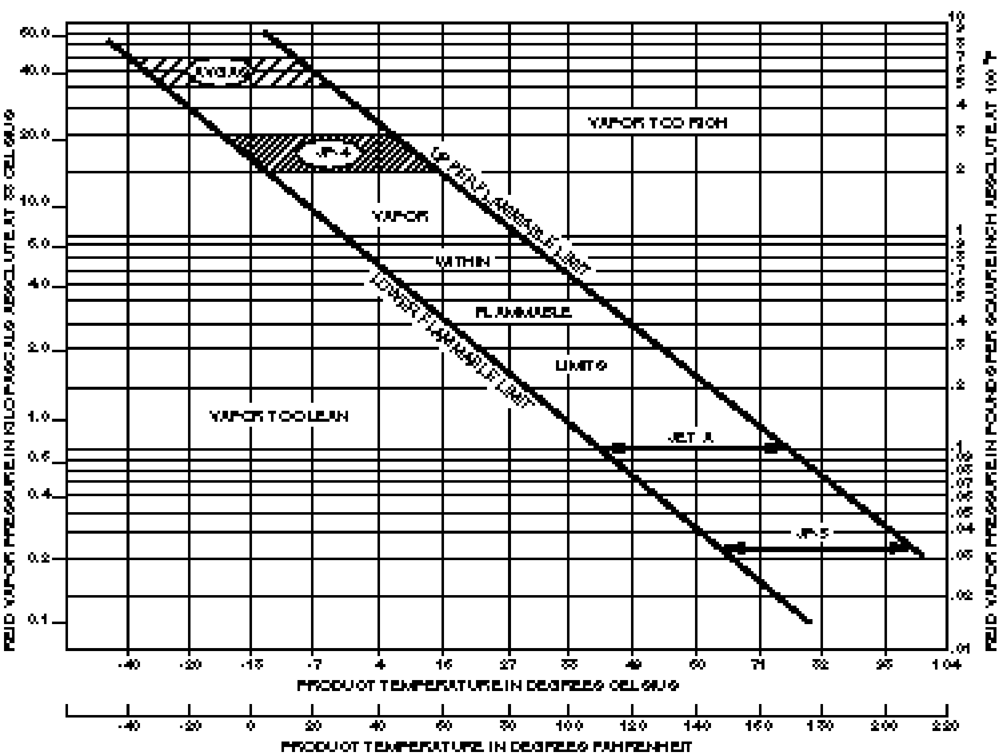



FIGURE 2. Relationship between temperature, rvp and flammable limits of petroleum products at sea level

8.3.3 Flame spread rates. The Naval Research Laboratory (NRL) has investigated the relationship among a fuel's flash point, temperature, and the speed with which a flame will spread across its surface. The results of this investigation are summarized on figure 3. The data clearly discloses a dramatic change in the behavior of a fuel once it has been heated 20 to 30 °F (-6.7 to –1 °C) above its flash point. The increased heating causes the flame spread rate to greatly increase. This is an important factor to keep in mind when handling the various types of fuels or aircraft containing them. If fuel spills onto a hot surface such as a flight deck, it will quickly assume the temperature of that surface and behave accordingly. Avoid introducing fuels into environments where the ambient or surface temperature exceeds the flash point of the fuel by greater than 20 °F (11 °C). Figure 4 illustrates the effects on flash point of mixing the different types of turbine fuels.

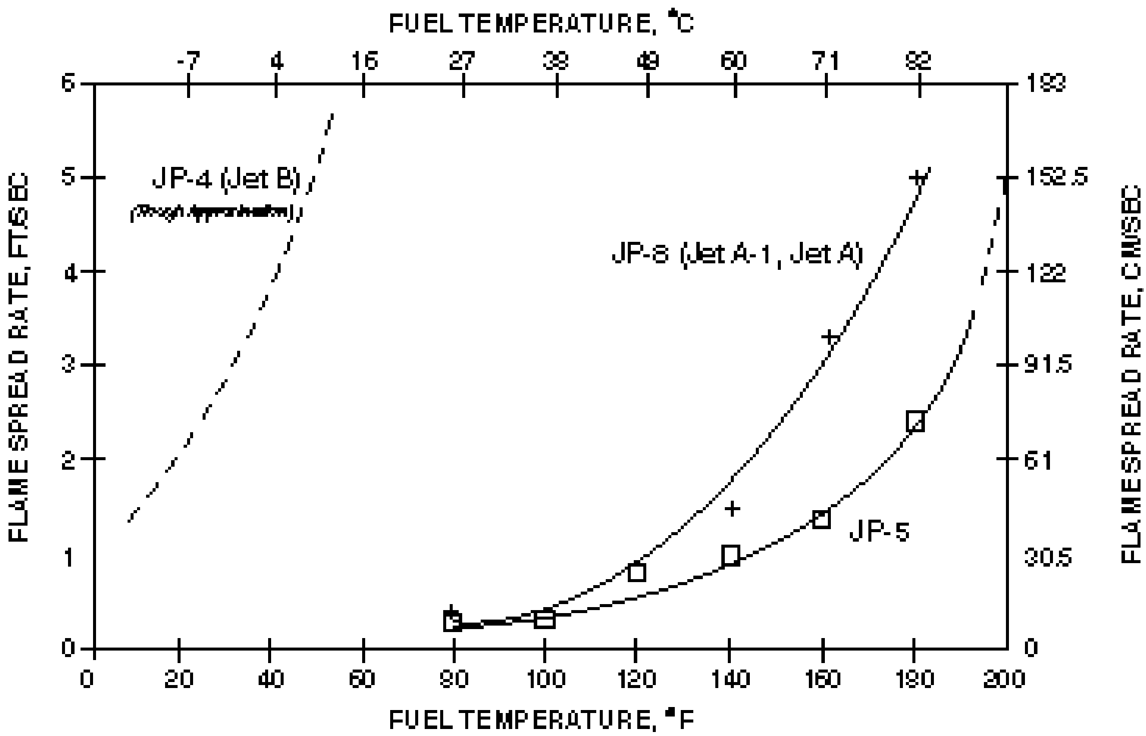



FIGURE 3. Flame spread rate versus temperature

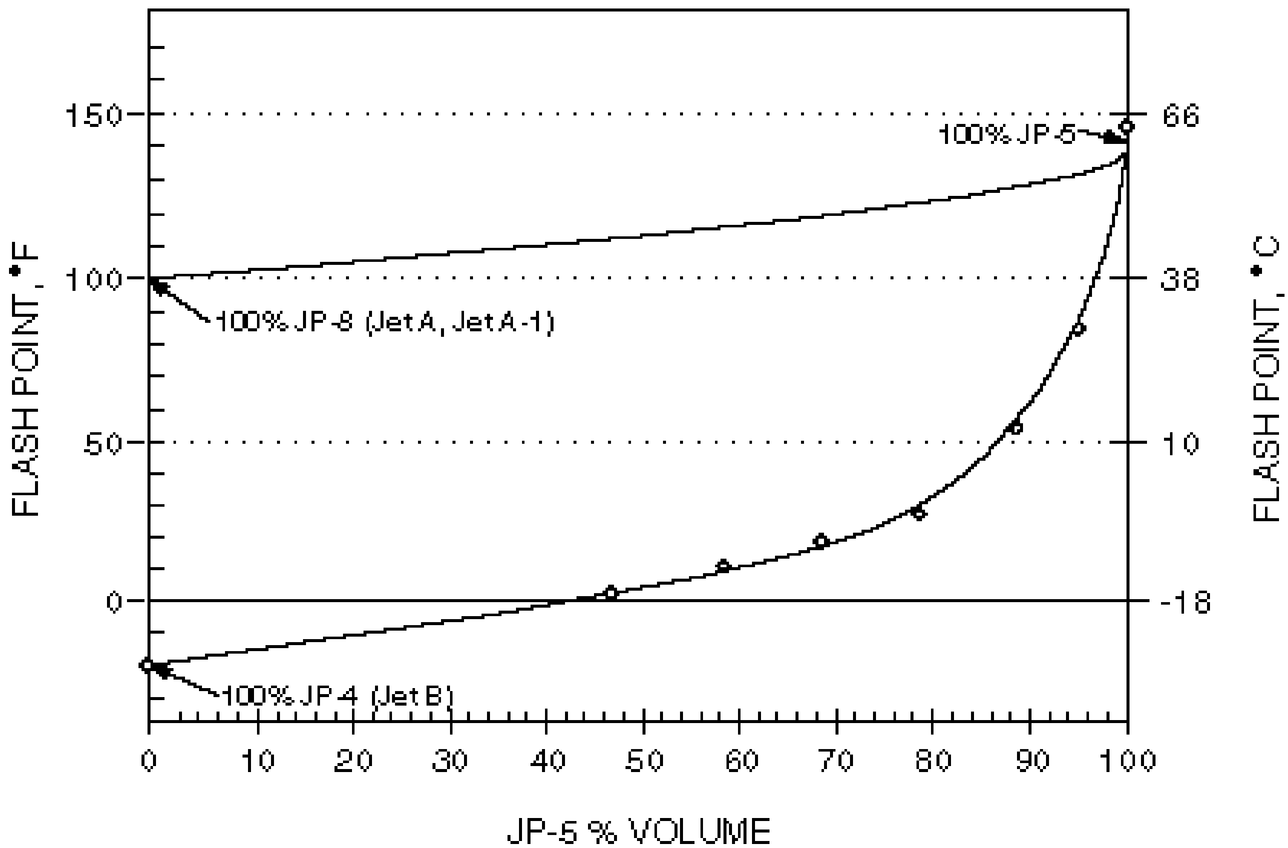



FIGURE 4. Flash point of turbine fuel mixtures

8.3.3.1 Relationship between flashpoint, temperature and extinguishment. NRL has also demonstrated a relationship among a fuel's flash point, temperature, and the degree of difficulty in extinguishing a fire. Similar to flame spread rates, the investigators found that the fire was significantly more difficult to extinguish if the temperature of the fuel was greater than or equal to 20 °F (11 °C) above the fuel's flash point.

8.4 Sources of ignition. There are many potential ignition sources, but the ones most likely to be present during the refueling and defueling operations are:

a. Static electricity spark.

b. Operating engines.

c. Arcing of electrical circuits.

d. Open flames.

e. Electromagnetic energy.

f. Hot surfaces or environment.

8.4.1 Static electricity. Static electricity is the term applied to the accumulation of electrical charges on materials and objects and the subsequent recombination (relaxation or discharge) of these charges. Static charges are created when two materials (or objects of differing composition) are rubbed or passed across each other. Negative charges (electrons) migrate to one material while positive charges accumulate in the other. For significant charges to be developed, the bodies should become and remain insulated from one another so that the electrons, which have passed from one surface to the other, become trapped when separation occurs. Insulation may occur through complete physical separation of the bodies or because at least one of the bodies is a poor conductor. The development of electrical charges may not of itself be a potential fire or explosion hazard. There should be a discharge or sudden recombination of separated positive and negative charges (sparking). In order for static to be a source of ignition four conditions should be fulfilled:

a. There should be an effective means of static generation.

b. There should be a means of accumulating the separated charges and maintaining a suitable difference of electrical potential.

c. There should be a spark discharge of adequate energy.

d. The spark should occur in an ignitable mixture.

8.4.1.1 Internal static. Since the mid-1950s, nearly 200 fires and explosions that occurred during aircraft fuel handling operations have been attributed to static discharges. Of all possible sources of static build-up that could occur during fueling and defueling operations, the real danger lies in the electrostatic charges generated by the movement of the fuel itself.

8.4.1.1.1 Charge generation. Internal static charges can be generated by the following:

a. Filtration. Whenever a hydrocarbon liquid, such as jet fuel, flows past any surface, a potential difference (electrical charge) is generated between the liquid and the surface. Filtration media provide tremendous amounts of surface area upon which such charge separation can take place as the fuel moves through them. For this reason filter/separators and fuel monitors are prolific charge generators.

b. Splash filling. Charges may be generated by splashing or spraying of a stream of fuel as it enters a tank, by the disturbance of the water bottom by the incoming stream, or by pumping substantial amounts of entrained air with the fuel. The amount of charge generated by splash filling depends on the configuration of the tank, the fuel inlet, the conductivity, foaming tendency and velocity of the fuel, and the existence in the fuel of pro-static agents. Pro-static agents are materials that greatly increase the charging tendency of the fuel without a corresponding increase in conductivity. Water, for example, has been found to be an efficient pro-static agent.

c Foam filled aircraft tanks. During the 1970s the USAF and Navy began placing polyurethane foam into aircraft tanks for fire protection purposes. The foam acts like a three-dimensional flame arrestor and suppresses ignition of fuel vapor by incendiary projectiles. Unfortunately the polyurethane foam did not prove durable and was replaced with a polyester foam, which has an approximately 10 times greater tendency to create a static charge when fuel flows across it. The designs of several USAF aircraft incorporate splash filling of their tanks through this foam medium. As a result, several of these aircraft have experienced small flash fires/explosions during refueling operations. While the damage to the aircraft is limited, repairs are usually expensive. U.S. Navy and Marine Corps aircraft do not incorporate splash filling in their tanks and have subsequently not had similar problems.

8.4.1.1.2 Charge accumulation. Since hydrocarbon fuels are relatively poor conductors of electricity, the charges built up in them relax (dissipate) slowly. It is therefore possible to pump highly charged fuel into a tank or aircraft. Once the fuel is in the tank, the unit charges of similar sign within the liquid are repelled from each other toward the outer surfaces of the liquid, including not only the surfaces in contact with the tank walls, but also the top surface adjacent to the air space. It is this “surface charge” that is of concern in fuel operations. If fuel were a perfect insulator the charge would remain indefinitely. However, there are no perfect insulators and the isolated charges in the fuel continually leak away to recombine with their counterparts on the tank shell which have migrated there from the filter/separator on the dispenser via the bonding cable. This leakage characteristic is called relaxation. Under the continuous influence of a charge generating mechanism, the accumulated voltage on the fuel (an insulated body) continues to increase. As the voltage becomes greater, the rate at which the charge will leak through the insulation (the fuel) to the tank shell will increase. At some voltage that is lower than the sparking potential, the leakage of the charge will be equal to the rate at which charge is being placed on the fuel and a stabilized condition will exist.

8.4.1.1.3 Static discharge or ignition. When sparking potential is reached before stabilization, a spark discharges from a portion of the fuel surface, the voltage immediately drops, and the entire process is resumed from the beginning. The fact that a spark occurs does not mean that a flammable mixture will ignite. For ignition, there should be sufficient energy transferred from the spark to the surrounding fuel vapor. Many factors such as material and shape of electrodes, the space of the gap, temperature, and pressure could decrease the availability of stored energy to the flammable mixture. The worst condition is a spark discharge from a floating, suspended, or attached but unbonded object in the tank since the entire amount of stored charge is released in a single discharge.

8.4.1.1.4 Control measures. The sizable static charges built up in fuel as it passes through filtration media can be effectively reduced to safe levels by passing the fuel through a relaxation chamber. Such devices slow down the velocity of the fuel and bring it into contact with metal surfaces bonded to the filter housing, thus giving the fuel both the time (a minimum of 30 seconds after it has passed through the filter) and the means to have its static charges recombine with those produced on the filter medium. This is the control approach used by the U.S. Navy and Marine Corps in fuel handling equipment. Relaxation chambers can be either actual tanks or large diameter pipes; the exact dimensions of the chamber should be determined from the maximum flow rate of the system. Tanks used for relaxation chambers should be baffled to avoid a tunneling effect as fuel enters and leaves. The relaxation chamber in a system does not negate the need for bonding the refueling equipment to the aircraft. The chamber only reduces the static charge on the fuel to safer levels, it does not completely eliminate the charge.

8.4.1.1.4.1 USAF approach to handling internal static charges. The USAF has taken a different approach to handling static charges generated in fuels. SDA is injected into JP-4 and JP-8 fuels to increase the fuel's conductivity and therefore the speed with which the static charges are relaxed. If the fuel's conductivity is high enough, charges will be sufficiently reduced prior to the fuel exiting the filter housing. SDAs tend to be lost in the supply system and should be periodically reinjected, thus requiring frequent monitoring of the fuel's conductivity level as well as facilities for reinjection.

8.4.1.1.4.2 Procedures for reducing internal static charges. The NATOPS Aircraft Refueling Manual contains a detailed list of procedures and actions that should be followed to help ensure the safe relaxation of internal static charges.

8.4.1.2 External static. Accident records indicate that the fire and explosion hazard from exterior static discharges during fuel operations is minimal; however, refueling personnel should be aware of the possible sources of external static and take proper precautions to further minimize and eliminate its impact.

8.4.1.2.1 Charge generation. There are five possible sources of exterior electrostatic charges on aircraft:

a. Movement of airborne charged particles, such as, snow, ice crystals, dust, or smoke.

b. Aircraft engines turning or other systems operating on the aircraft.

c. Cloud induced fields. The heavily charged clouds of an electrical storm set up an electrostatic field over a large area of the earth's surface below them. The "field" induces static on the earth, aircraft, refueler, etc.

d. Movement of a charged object onto aircraft. Fitting in this category is static from over-the-wing nozzles, probably transferred from personnel while the nozzle was insulated from both the refueler and aircraft prior to the initiation of fuel flow .

e. Lightning. Electrostatic currents resulting from both distant as well as direct lighting strikes are more severe by orders of magnitude than those from any other source.

8.4.1.2.2 Charge accumulation and dissipation. The amount of electrostatic charge that can accumulate on an insulated body, such as a rubber-tired aircraft or refueler, depends upon the rate at which the static is generated and the resistance of the paths by which the charge leaks off. On concrete parking aprons the tire-surface contact-resistance paths will provide sufficient discharge capability to prevent the accumulation of static charges. Asphalt, especially when dry, is a much better insulator than concrete and therefore dissipates static charges much more slowly. The extremely large static charges that have accumulated on aircraft during flight are dissipated in short periods of time after landing; but fueling operations should not commence until adequate time has elapsed to ensure the dissipation of accumulated charges. Turning engines and helicopter rotors are also strong static generators and sufficient time should be allowed after they have been turned off for the charges created to dissipate. Since most refueling operations are conducted on concrete, less than a minute is needed to completely relax these charges; however, waiting 3 minutes will ensure safety. Any refueling operations conducted on asphalt or any surface other that concrete should be classified as abnormal and thus subject to special procedures including earthing (grounding) of the aircraft and refueler. Any refueling operations conducted with aircraft engines or other equipment operating (with the exception of fuel system switches) should be considered abnormal and also subject to special procedures including earthing.

8.4.1.2.3 Control Measures for External Static. During normal fueling and defueling operations on concrete surfaces, tire-surface contact can be relied upon to prevent the accumulation of static charge. Specific procedures to be followed are contained in the NATOPS Aircraft Refueling Manual.

8.4.2 Operating engines. The operation of aircraft engines, automobile engines, or other internal combustion engines can provide sources of ignition. Ignition of vapors may occur through the arcing of distributor points, arcing at spark plugs, loose spark plug wires, hot engine exhaust piping, and backfiring. The starting of engines with their susceptibility to false starts, malfunctions, and fires during the cranking phase, are likely sources of fuel vapor ignition. Stopping an engine, as opposed to leaving it running, is more apt to provide an ignition source because of possible dieseling, backfiring, or malfunctioning when the engine’s ignition is turned off.

8.4.3 Arcing of electrical circuits. Arcing of electrical circuits is another common source of ignition in fuel handling operations. Sparks may occur when battery terminals are connected or when an electrical switch is operated. Other examples of sparks from electrical circuits are arcing of generator brushes, arcing of welding machine brushes, arcing of brushes on electrical motors and tools, and the arcing that occurs in short circuits. Defective aircraft electrical circuits have been known to melt the plastic coatings on bonding and earthing cables during refueling operations; cables have even turned cherry-red, burned, and disintegrated, moments after the earth cable was attached to the earth point. Static earthing cables are not adequate protection against such stray currents.

8.4.4 Open flames. Open flames and lights are obvious sources of ignition. These include cigarettes, cigars, pipes, exposed flame heaters, welding torches, blow torches, flare pots, gasoline or kerosene lanterns, matches, cigarette lighters, and others. Similar to this hazard of open flames is that of standard electric light bulbs. Should any of these bulbs break, the filament will become hot enough to ignite a vapor-air mixture and cause a fire or explosion.

8.4.5 Electromagnetic energy. High-frequency transmitting equipment, including radar, mounted in aircraft or mobile units, automotive equipment, or on the ground can provide sufficient electromagnetic energy to ignite fuel vapors. For this reason, refueling or defueling operations should not be conducted within 30 meters (100 feet) of operating airborne radar equipment, or within 91 meters (300 feet) of operating ground radar equipment installations.

8.4.6 Hot surfaces or environment. Fuel or fuel vapors can come into contact with surfaces sufficiently hot to cause autoignition of the fuel or vapor. Examples are a high-pressure fuel leak hitting a hot brake or metal particles from a welding, filing, or cutting operation contacting the fuel vapor. Some areas of the aircraft, such as the bomb bay, may provide a hot enough environment for autoignition of any fuel that leaks into the area. Although actual autoignition temperatures may vary a great deal depending on the specific fuel involved and its environment, the minimum temperatures can safely be assumed to be above 700 °F for turbine fuels.

8.5 Extinguishment.

8.5.1 General. Although the Air Station's Crash Crew (Crash, Fire, and Rescue) or Ship's Crash Crew has primary responsibility for firefighting, all fuel handling personnel should be aware of the basic principles involved in extinguishing fires as well as the equipment used. They should also make certain that appropriate fire fighting equipment, in good condition, is readily available whenever and wherever fuel handling operations are being conducted. For maximum effectiveness and safety, fire extinguishers should be operated in accordance with the specific procedures developed for each individual type. The following information has been extracted from the U.S. Navy Crash, Fire and Rescue NATOPS Manual, NAVAIR 00-80R-14, and is presented here to provide refueling personnel with general information on fire chemistry, classification, and methods of extinguishment.

8.5.2 Fire chemistry. For many years, fire was considered to be the product of a combination of three elements — fuel, an oxidizing agent, and temperature. Research in the past 30 years has indicated the presence of a fourth critical element. The fourth element is the chemical chain reaction that takes place in a fire and allows the fire to both sustain itself and grow. For example, in a fuel fire, as the fire burns, fuel molecules are reduced within the flame to simpler molecules. As the combustion process continues, the increase in the temperature causes additional oxygen to be drawn into the flame area. Then, more fuel molecules will break down, enter into the chain reaction, reach their ignition point, begin to burn, cause a temperature increase, draw additional oxygen, and continue the chain reaction. As long as there is fuel and oxygen and as long as the temperature is sustained, the chain reaction will cause the fire to grow.

8.5.3 Classification of fires.

8.5.3.1 Class A fires. Class A fires, which includes burning wood and wood products, cloth, textiles and fibrous materials, paper and paper products, are extinguished with water in straight or fog pattern. If fire is deep seated, aqueous film forming foam (AFFF) can be used as a wetting agent.

8.5.3.2 Class B fires. Class B fires, which includes gasoline, jet fuels, oil, and other flammable/combustible liquids, are extinguished with AFFF, Halon 1211, purple-K-powder (PKP), and carbon dioxide ($CO_2$).

8.5.3.3 Class C fires. A Class C fire involves energized electrical equipment. Extinguishment tactics are: de-energize and treat as a Class A, B, or D fire; attack with application of non-conductive agents ($CO_2$, Halon, PKP); or attack with application of fresh or salt water in fog patterns maintaining nozzle at least 4 feet from the energized object.

8.5.3.4 Class D fires. Class D fires, which includes combustible metals such as magnesium and titanium, are extinguished with water in large quantities such as high-velocity fog. When water is applied to burning Class D material, there may be small explosions. The firefighter should apply water from a safe distance or from behind shelter.

8.5.4 Fire extinguisher types, agents, and methods of application. The best application technique varies with the type of extinguishing agent and associated hardware. Some fire extinguishers deliver their entire quantity of extinguishing agent within 10 seconds, while others are designed to be operated for 30 seconds or longer. The agent should be applied correctly at the outset since there is seldom time to experiment. Using a portable extinguisher at too close a range may scatter the fire; using it at a distance beyond the effective range will simply waste the extinguishing agent.

**WARNING**

- Firefighters should use caution in fighting fuel fires and be prepared to back out well before the extinguisher contents are exhausted.

- Halon, PKP, and $CO_2$ are all rapidly dissipated and no vapor sealing property is developed, so the fuel is always subject to reignition. Discharge should be continued for a short time after the flames are extinguished to prevent possible reflash and to cool any ignition sources in or near the fire.

**WARNING**

Portable and wheeled Halon, PKP, and $CO_2$ extinguishers should be discharged in an upright position. If the extinguisher is on its side or inverted, the siphon tube will not reach the agent and an unsatisfactory discharge will result.

8.5.4.1 Halon 1211 (Bromochlorodifluoro-methane) portable and wheeled unit extinguishers. These extinguishers are intended primarily for use on Class B and C fires; however, Halon 1211 is effective on Class A fires. Halon 1211 is a colorless, faintly sweet smelling, electrically nonconductive gas that leaves no residue to clean up.

8.5.4.1.1 Extinguishment mechanism. Halon 1211 extinguishes fires by inhibiting the chemical chain reaction of the combustion process. Halon 1211 is virtually non-corrosive, nonabrasive, and is at least twice as effective as $CO_2$ on Class B fires when compared on a weight-of-agent basis. Although the agent is retained under pressure in a liquid state and is self-expelling, a booster charge of nitrogen is added to ensure proper operation. Upon actuation, the vapor pressure causes the agent to expand so that the discharge stream consists of a mixture of liquid droplets and vapor. Halon 1211 extinguishers are marked with a reflective silver band around the tank.

**WARNING**

Do not use Halon 1211 on Class D fires. It has no blanketing effect and, if it reaches a Class D fire in the liquid state, the possibility of an explosive reaction exists.

**WARNING**

The discharge of Halon 1211 to extinguish a fire creates a hazard to personnel, such as dizziness and impaired coordination, from the natural Halon 1211 product and from the products of decomposition that result through exposure of the agent to the fire. Exposure to the agent is of less concern than is the exposure to the products of decomposition. In using extinguishers of this type in unventilated spaces or confined areas, operators should use positive-pressure, self-contained breathing apparatus.

8.5.4.1.2 Application. Initial application should start close to the fire. On all fires, the discharge should be directed at the base of the flames. Sweep the agent stream back and forth across the leading edge of the fire, overshooting on both sides, and continue to push the leading edge of the fire back until the fire is extinguished. These units have an effective discharge range of 10 to 30 feet (3 to 9 meters), depending on ambient conditions, and a discharge time of 15 to 40 seconds, depending on the extinguisher size and application rate.

8.5.4.2 Carbon Dioxide ($CO_2$) 15-pound portable units and 50-pound wheeled extinguisher units. These units are intended primarily for use on Class B and C fires. $CO_2$ is a colorless, odorless gas that is approximately 1-1/2 times heavier than air. It is stored in rechargeable containers designed to hold pressurized carbon dioxide in liquid form at atmospheric temperatures. Fire suppression is accomplished by the displacement of oxygen in the atmosphere to a level below the percent required to support combustion.

**WARNING**

Exposure to $CO_2$ in high concentrations for extended periods of time can be fatal.

**WARNING**

The use of portable $CO_2$ extinguishers to inert flammable atmospheres is prohibited. When a portable $CO_2$ extinguisher is discharged, the liquid $CO_2$ expanding through the nozzle and cone becomes solid (commonly called “snow”). This “snow” contacting and separating from the extinguisher cone becomes electrically charged, as does the extinguisher itself. If the charged “snow” contacts an insulated metal object, it will cause the object to become charged. Tests indicate that voltages greater than 15 kilovolts can be developed on insulated metal objects from a 1- to 2-second application of $CO_2$ from an extinguisher. This voltage is sufficient to cause a spark.

8.5.4.2.1 Application. Agent application should commence at the upwind edge and be directed slowly in a side-to-side sweeping motion, gradually moving toward the back of the fire. These extinguishers have a limited discharge range of 3 to 8 feet and a discharge time of 8 to 44 seconds, depending on the extinguisher size and application rate.

8.5.4.3 Purple-K-Powder (PKP) dry chemical powder extinguishers. These extinguishers are intended primarily for use on Class B fires. The principal base chemical used in the production of PKP dry chemical agent is potassium bicarbonate. Various additives are mixed with the base material to improve its stowage, flow, and water repellency characteristics. The ingredients used in PKP are nontoxic; however, the discharge of large quantities may cause temporary breathing difficulty, may seriously interfere with visibility, and may cause disorientation. Dry chemical agent does not produce a lasting inert atmosphere above the surface of flammable liquid; consequently, its use will not result in permanent extinguishment if reignition sources are present. These extinguishers are marked with a purple band around the tank.

**CAUTION**

- Chemical agents may harden after being exposed to moisture. It is therefore important to avoid exposing them to any moisture during stowage, handling, and recharging evolutions.

- When PKP is used as the fire suppression agent on an aircraft fire and the agent is directed or ingested into an engine or accessory section, the fire chief, on-site personnel using the extinguisher, or senior fire official should notify the maintenance officer of the unit involved or, in the case of a transient aircraft, the supporting facility. PKP injected into a jet engine cannot be completely removed without disassembly of the engine to remove deposits that penalize engine performance and restrict internal cooling air passages.

8.5.4.3.1 Application. These extinguishers have a discharge range of approximately 3 to 30 meters (10 to 40 feet), depending on extinguisher size. Discharge time varies from 8 to 60 seconds. When used on flammable liquid fires, the stream should be directed at the base of the flame, gradually moving toward the back of the fire while sweeping the nozzle rapidly from side to side.

8.5.5 Fire extinguisher requirements. Figure 5 lists the requirements of fire extinguishers around different types of operations. This figure has been extracted from NAVAIR 00-80R-14, which is the controlling document and should be consulted for the latest requirements.

<table>
<tr><th>TYPE OF OPERATION</th><th>FIRE PROTECTION REQUIREMENT</th></tr>
<tr><td colspan="2">Note<br>All references to Halon 1211 extinguishers are for the 150-pound wheeled unit. Current in-service 150-pound PKP extinguishers are acceptable until Halon units can be placed in service.</td></tr>
<tr><td colspan="2">FLIGHT LINE PARKING AREA</td></tr>
<tr><td>A. SMALL OR MEDIUM TYPE AIRCRAFT<br>C-12, T-2, T-34, T-38, T-44, T-45, TA-4, EA-6B, AV-8, F-4, F-14, F-15, F-16, F-117, F-22, F/A-18, JSF, T-39, S-3, E-2, C-2, UH-1, AH-1, SH-2, H-3, TH-57, H-46, H-60</td><td>1 Halon 1211 extinguisher per 3 aircraft.</td></tr>
<tr><td>B. LARGE TYPE AIRCRAFT<br>P-3, C-9, C-20, DC-10, C-5 (See Note), C-17, C-130, C-131, C-141, E-6A, KC-135, 707, 727, 737, 747, L-1011, KC-10, H-53, V-22</td><td>1 Halon 1211 extinguisher per 2 aircraft.</td></tr>
<tr><td colspan="2">Note<br>• Two Halon 1211 extinguishers are required for each C-5 aircraft.<br>• If any substitutions are required, the substituted unit should be approved by the fire department of CFR unit. As a general rule, any substitute portable extinguishing unit should have the same extinguishing capability as the Halon unit replaced.</td></tr>
<tr><td>C. HOT REFUELING — Transfer of fuel into aircraft tanks with one or more aircraft engines operating.</td><td>The minimum fire protection shall be two 150-pound Halon 1211 wheeled units positioned at each lane/island.</td></tr>
<tr><td colspan="2">Note<br>A crash fire vehicle (TAU) shall be on standby alert during multiple aircraft hot refueling operations. The location and response criteria will be determined by the Fire Chief/CFR Officer.</td></tr>
<tr><td>D. CONCURRENT FUELING AND SERVICING OR AIRCRAFT WITHOUT PASSENGERS</td><td>1 Halon 1211 extinguisher. Additionally, one major crash fire vehicle as specified in paragraph 5.2 shall be capable or responding to the scene within 3 minutes.</td></tr>
<tr><td>E. FUELING OF AIRCRAFT WITH PASSENGERS</td><td>1 Halon 1211 extinguisher. Additionally a TAU or major crash fire vehicle as specified in paragraph 5.2 shall be positioned at the aircraft.</td></tr>
<tr><td colspan="2">Note<br>Fire department/CFR unit shall be alerted at least 15 minutes prior to commencement of fueling operations. The number of passengers on board the aircraft shall be included in the notification.</td></tr>
</table>

FIGURE 5. Airfield fire protection requirements

| TYPE OF OPERATION | FIRE PROTECTION REQUIREMENT |
|---|---|
| F. FUELING OR SERVICING OF MEDICAL EVACUATION FLIGHTS WITH PASSENGERS/PATIENTS ON BOARD | 1 150-pound Halon 1211 wheeled extinguisher. Additionally, one major CFR vehicle shall be positioned at the aircraft for optimum response. Turrets shall be manned and agent pumping equipment/systems ready for instant activation. |
| **Note** Fire department/CFR unit shall be alerted at least 15 minutes prior to commencement of fueling operations. The number of passengers on board the aircraft shall be included in the notification. | |
| G. HIGH POWER AND NEW ENGINE TURN-UP | 2 Halon 1211 extinguishers located in immediate vicinity. One major CFR vehicle shall be capable of responding to the site within 3 minutes. |
| **Note** Fire department/CFR unit shall be notified at least 15 minutes prior to commencement of new engine turn-up. | |
| H. COMBAT AIRCRAFT ORDNANCE LOADING AREA | 1 Halon 1211 extinguisher per 2 aircraft. |
| **Note** Fire department/CFR unit shall be notified of daily ordnance loading/unloading schedule. | |

FIGURE 5. Airfield fire protection requirements – Continued.

8.6 Health hazards.

8.6.1 General. Aviation fuels should be handled with caution because of the obvious dangers associated with possible fires, explosions, or both. These materials also 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. In an attempt to comply with a recently enacted California law, Exxon Company U.S.A. has issued the following warning statement to inform people of the potential health hazards associated with all petroleum products including fuels:

> Detectable amounts of chemicals known to the State of California to cause cancer, birth defects or other reproductive harm may be found in petroleum products,

intermediate products, by-products, waste products, and chemical products, and their vapors or result from their use. Read and follow label directions and other product safety and health information that you have been provided when handling or using these materials.

8.6.2 Principal health hazards. The following paragraphs discuss the principal health dangers from aviation fuels. Once these dangers are known and understood, they can be easily avoided by controlling or minimizing exposure of personnel to both the liquid and vapor forms of the fuels.

8.6.2.1 Toxic vapor effect. One of the greatest health hazards to fuel handling personnel is the toxic effect of the fuel vapors. Only a very small amount of fuel vapor in the air is sufficient to cause harmful effects. Since most fuel handling operations are usually conducted in the open, fuel vapors are sufficiently diluted by the ambient air so that there is no hazard to personnel. In the event of a fuel spill or a leak in an enclosed area, personnel should be very careful to avoid inhalation of the fuel vapors.

8.6.2.1.1 Symptoms and remedial action. The first symptoms of the toxic effect of breathing fuel vapors are nausea, dizziness, and headaches. If any of these symptoms are noted while conducting fuel handling operations, personnel should immediately stop the operation and move to a fresh air location. If personnel are overcome by vapors, they should receive prompt medical attention. First aid procedures for personnel overcome by vapors include removal to fresh air, treatment for shock, and administering of artificial respiration if breathing has stopped.

8.6.2.2 Lead poisoning. The tetraethyl lead that is added to all grades of AVGAS is very poisonous. It is harmful if the vapors are inhaled or if the compound enters the body through the mouth by skin contact. The principal danger of lead poisoning occurs when it is necessary to enter or repair containers that have been used for leaded gasolines. Refueling and defueling personnel normally will not have to do such work, but it is important that they be aware of the danger, and that they know never to enter a tank or vessel which has contained leaded gasoline until the necessary safety precautions have been followed. The toxic effect of tetraethyl lead may also occur from prolonged exposure to gasoline vapors or liquids and, therefore, such exposure should be avoided. Another danger from leaded gasoline is from the fumes given off by stoves or lanterns burning a gasoline containing tetraethyl lead. For this reason, leaded gasoline should never be used for such purposes.

8.6.2.3 Injury to skin and eyes. AVGAS and jet engine fuels may cause irritation if brought in contact with the skin. For this reason, direct skin contact with fuel should be avoided. If fuel is accidentally spilled on personnel, affected clothing should be removed immediately. Any skin areas exposed to fuel should be promptly washed with soap and water.

**Note**

If a person accidentally gets gasoline or jet fuel in the eyes, the fuel should be immediately removed by rinsing them with plenty of water. Medical attention should be administered as soon as possible.

8.6.2.4 Swallowing aviation fuels. Swallowing even small amounts of aviation fuels is very harmful and medical attention should be obtained immediately.

8.6.2.5 Fuel tank and filter/separator water bottoms. The water that collects in the bottom of fuel tanks and filter/separator often contains a high percentage (40 to 60 percent) of fuel system icing inhibitor (FSII). Since FSII (DiEGME) is considered toxic in a pure or concentrated state, exposure of personnel to water bottoms of filter separators and tanks should be kept to the absolute minimum. If exposure occurs, wash with soap and water followed by a thorough fresh water rinse. Disposal of water bottoms should be accomplished in accordance with local environmental regulations.

8.6.2.6 Specific procedures for avoiding the health hazards of aircraft fuels. The Aircraft Refueling NATOPS Manual (NAVAIR 00-80T-109) contains a list of procedures which will minimize the dangers to the health of fuel handling personnel.

# 9. NOTES

9.1 Intended use. This handbook is intended for use by Navy and Marine Corps aircraft refueling organizations afloat and ashore.

9.2 Subject term (key word) listing.

AVGAS
Aviation turbine fuel
B/2 Test Kit
Biostat
CFD
CCFD
Conductivity
Fire extinguisher
Free water
FSII
FWD
Icing inhibitor
JP-4
JP-5
JP-8
Microbiological growth
Quality surveillance
SDA
Static electricity
Tetraethyl lead
Water bottoms

9.3 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

# APPENDIX A

# VISUAL CONTAMINATION

## A.1 SCOPE

A.1.1 Scope. This appendix describes, in tabular format, the most commonly seen types of aviation fuel contamination along with their visual appearance, effect on aircraft, and acceptable limits.

## A.2 CONTAMINATION

A.2.1 Visual contamination table. See Table A-I.

# APPENDIX A

## TABLE A-I. Visual contamination table

| CONTAMINANT | APPEARANCE | CHARACTERISTICS | EFFECTS OF AIRCRAFT | ACCEPTABLE LIMITS |
|---|---|---|---|---|
| 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 filter 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 or fresh. Cloud usually indicates water-in-fuel emulsion. | Icing of fuel system — usually low pressure fuel filters. Erratic fuel gauge readings. Gross amounts of water can cause flame-outs. Sea water will cause corrosion of fuel system components. | Zero — fuel should 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<br><br>Black rust ($Fe_3O_4$) — magnetic<br><br>Rust generally comprises major constituent of particulate matter. | Will cause sticking and sluggish or general malfunction of fuel controls, flow dividers, pumps, nozzles, etc. | Fuel should contain less than 2 mg/liter. |
| 2. Sand or Dust | Crystalline, granular, or glass-like. | Usually present and occasionally constitutes major constituent. | Will cause sticking, and sluggish or general malfunction of fuel controls, flow dividers, pumps, nozzles, etc. | Fuel should contain less than 2 mg/liter. |
| 3. Aluminum | White or grey powder or paste. | Sometimes very sticky or gelatinous when wet with water. Often present and occasionally represents major constituent. | Will cause sticking, and sluggish or general malfunction of fuel controls, flow dividers, pumps, nozzles, etc. | Fuel should contain less than 2 mg/liter. |

# APPENDIX A

TABLE A-I. Visual contamination table - Continued.

| CONTAMINANT | APPEARANCE | CHARACTERISTICS | EFFECTS OF AIRCRAFT | ACCEPTABLE LIMITS |
|---|---|---|---|---|
| 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.<br>Heavy cloud. | Finely divided drops of water in fuel. Same as free water could. Will settle to bottom in minutes, hours, or weeks depending upon nature of emulsion. | Same as free water. | Zero — Fuel should contain no visually detectable free water. |
| 2. Fuel and water or "stabilized" | Reddish, brownish, grayish or blackish. Sticky material variously described as gelatinous, gummy, or like catsup or mayonnaise. | Finely divided drops of fuel in water. Contains rust or microbiological growth that stabilizes or "firms" the emulsion. Will adhere to many materials normally in contact with the fuels. Usually present as "globules" or stringy, fibrous-like 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 are present. | Same as microbiological growth. | Zero — There should be no free water. |
| 2. Air Bubbles | Cloud in fuel. | Disperses upward within a few seconds. | None. | Any amount. |

# APPENDIX B

# PETROLEUM TESTING LABORATORIES

## B.1 SCOPE

B.1.1 Scope. This appendix provides guidance on two types of aviation fuel samples and provides the addresses of military petroleum testing laboratories.

## B.2 INFORMATION

B.2.1 General Informationl. Aviation fuels require quality surveillance from the point of initial acceptance until they are actually used in the aircraft. Every activity and individual in the supply system that transports, stores, distributes, or issues these products is responsible for some phase of quality surveillance. Two types of samples are required to ensure quality fuel for aircraft: Special and Routine. Definitions for each of these types of samples and procedures for field personnel to follow in submitting them are contained in the following paragraphs.

## B.3 SAMPLES

B.3.1 Special samples. These are samples that are submitted for testing because the quality of the fuel is suspect either as a result of aircraft malfunctions or for other reasons.

B.3.1.1 Shipping Destinations. Special samples should be taken in duplicate and shipped to both the Naval Air Systems Command (AIR-4.4.5) and to the nearest regional laboratory contained in table B-VI (regional laboratories are indicated by an asterisk (*) next to their location). AIR-4.4.5 is available to assist field personnel worldwide in the identification and resolution of quality problems and is responsible for determining whether off-specification fuel can be issued to aircraft. AIR-4.4.5's address and telephone numbers are listed in table B-VII. NOLSC-DC (see table B-VIII for address) should be informed of all special samples sent when off-specification fuel is suspected.

B.3.1.2 Sample size**.** Each laboratory will require a minimum quantity of 1 gallon (3.8 liters) This means two 1-gallon samples of fuel should be extracted from each problem location. Ship both samples by the fastest traceable means — the first gallon to AIR-4.4.5 and the second to the nearest regional laboratory.

B.3.1.3 Shipping container. Use the standard red shipping container specified in MIL-K-23714 or other IATA approved packaging.

B.3.1.4 Documentation. When a fuel quality problem is encountered the activity should contact AIR-4.4.5 via telephone immediately and follow up with a Naval message, telefax, email, or letter that describes the problem and identifies a point of contact. All samples should be properly labeled with all pertinent information. (See sections 3.3.3, 9.3.3 and 15.3.3 in the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109).

# APPENDIX B

B.3.2 Routine samples. Routine samples are samples taken when no fuel problems or aircraft problems attributable to the fuel are known or suspected. These samples and their test results serve two purposes:

1. They assist the activity in monitoring the performance of their local fuel testing equipment and methods.

2. They provide TYCOM and SYSCOM cognizant offices with information on the general quality of the fuel delivered to aircraft and the performance of the fleet's quality control equipment.

Routine sample size and submission frequency are contained in the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, sections 3.3, 9.3, and 15.3. Routine fuel samples should be shipped to the nearest or most convenient laboratory contained in Table B-I.

## B.4 PETROLEUM TESTING LABORATORIES

B.4.1 The laboratories listed in table B-I are equipped to perform all tests required by aviation fuel specifications. All samples sent for testing should be properly labeled with all pertinent information as specified in NAVAIR 00-80T-109 Aircraft Refueling NATOPS Manual sections 3.3.3, 9.3.3, and 15.3.3. Special samples (see B.3.1) should be shipped to the closest laboratory annotated with an asterisk (*) next to its location in table B-I.

TABLE B-I. Petroleum testing laboratories

| Location | Laboratory Shipping Address | Lab Mailing Address |
|---|---|---|
| *East Coast* | | |
| *Norfolk, VA | Mid-Atlantic Fuels Testing Laboratory<br>9673 Virginia Ave.<br>Building W-388, Code 134.14<br>Norfolk, VA 23511-3323<br><br>Telephone:<br>DSN — 564-4364<br>Commercial — 757-444-2761 | Same as shipping address. |
| Jacksonville, FL | Director, Fuel Department (Code 700)<br>FISC<br>8808 Somers Road, Bldg. 56<br>Jacksonville, FL 32218-2600<br><br>Telephone:<br>DSN — 942-4907<br>Commercial — 904-696-5411 | Same as shipping address. |

# APPENDIX B

TABLE B-I. Petroleum testing laboratories - Continued.

| Location | Laboratory Shipping Address | Lab Mailing Address |
|---|---|---|
| *Searsport, ME | Director, Aerospace Fuels Laboratory<br>Det 20, SA-ALC/SFTLB<br>Trundy Rd, Bldg. 14<br>Searsport, ME 04974-0408<br><br>Telephone:<br>Commercial — 207-548-2451<br><br>(Note: Searsport is scheduled for closure during CY-2005) | Det 20, SA-ALC/SFTLB<br>P.O. Box 408<br>Searsport, ME 04974-0408 |
| *Dayton, OH | Director, Aerospace Fuels Laboratory<br>Det 13, SA-ALC/SFTLA<br>Area B, Bldg. 70, Suite 1<br>Wright-Patterson AFB, OH 45433-7632<br><br>Telephone:<br>DSN — 785-5687/2106<br>Commercial — 573-255-5687 | Same as shipping address. |
| *West Coast* | | |
| *San Diego, CA | Fleet and Industrial Supply Center<br>Point Loma Submarine Base<br>Bldg. 50<br>199 Rosecrans<br>San Diego, CA 92106<br><br>Telephone:<br>DSN — 553-1326<br>Commercial — 619-553-1326 | Director, Fuel Department<br>FISC San Diego<br>Code 700<br>937 North Harbor Dr., Suite 480<br>San Diego, CA 92132-0480 |
| Seattle, WA | Naval Supply Center<br>7501 Beach Drive<br>Port Orchard, WA 98366<br><br>Telephone:<br>DSN — 439-2135<br>Commercial — 360-476-2135 | Director, Fuel Department (Code 700)<br>FISC Puget Sound<br>P.O. Box 8<br>Manchester, WA 98353-0008 |
| *Pacific* | | |
| *Pearl Harbor, HI | NSC Pearl Harbor POL Lab<br>Director, Fuel Department<br>Naval Supply Center<br>Code 700, Box 300<br>Pearl Harbor, HI 96860-5300<br><br>Telephone:<br>DSN — 471-9344<br>Commercial — 808-471-9344 | Same as shipping address. |

APPENDIX B

TABLE B-I. Petroleum testing laboratories – Continued.

| Location | Laboratory Shipping Address | Lab Mailing Address |
|---|---|---|
| *Note: NSC Pearl Harbor facilities should be used by units in the Central Pacific.* | | |
| Guam, Marianas Island | Commander (Code 701)<br>U.S. FISC Guam<br>PSC 455, Box 190<br>FPO AP 96540-1500<br><br>Telephone:<br>DSN — 339-7106<br>Commercial — 671-339-7106 | Same as shipping address. |
| Sasebo, Japan | Officer in Charge (Code 804)<br>U.S. FISC Yokosuka, Det Sasebo<br>PSC 476, Box 7<br>FPO AP 96322-1504<br><br>Telephone:<br>DSN — 252-4136/4126<br>Commercial — 87-956-24-4136/4126 | Same as shipping address. |
| Okinawa, Japan | Director, Aerospace Fuels Laboratory<br>Det 44, SA-ALC/SFTLG<br>Unit 5161<br>Kadena AB Japan<br>APO AP 96368-5161<br><br>Telephone:<br>DSN — 315-634-3394/1602<br>Commercial — 81-611-735-1602 | Same as shipping address. |
| Yokosuka, Japan | Fuel Department Director<br>FISC<br>Code 700<br>PSC 473, Box 11<br>FPO AP 96349-1500<br><br>Telephone:<br>DSN — 244-2733<br>Commercial — 87-311-744-2733 | Same as shipping address. |
| *North Atlantic* | | |
| *Keflavik, Iceland | Commanding Officer<br>NAS Keflavik, IC<br>Fuels Officer (Code 403)<br>PSC 1003, Box 32<br>FPO AE 09728-0332<br><br>Telephone:<br>DSN — 450-6299<br>Commercial — 611-354-425-6299 | Same as shipping address. |

APPENDIX B

TABLE B-I. Petroleum testing laboratories - Continued.

| Location | Laboratory Shipping Address | Lab Mailing Address |
|---|---|---|
| *Suffolk, England UK | Director, Aerospace Fuels Laboratory<br>OL SA-ALC/SFTLF<br>Bldg. 725<br>Mildenhall AB, UK<br>APO AE 09459-5000<br><br>Telephone:<br>DSN — 314-238-2043/2797<br>Commercial — 44-638-54-2043/2797 | OL SA-ALC/SFTLF<br>Unit 5025<br>APO AE 09459-5000 |
| *Mediterranean and Middle East* | | |
| *Rota, Spain | Fuels Division<br>US Naval Station Rota<br>PSC 819 BOX 21<br>FPO AE 09645-4900<br><br>Telephone:<br>DSN — 727-2569<br>Commercial — 34-956-82-2569 | Same as shipping address |
| *Indian Ocean* | | |
| *Diego Garcia | Commanding Officer<br>U.S. Naval Support Facility<br>Code 407<br>PSC 466, Box 4<br>FPO AP 96595-0004<br><br>Telephone:<br>Operator Assisted — 246-370-8445 | Same as shipping address. |

Additions, corrections, or changes to the above table should be forwarded to:

Commander
Naval Air Systems Command
AIR-4.4.5, Bldg. 2360
22229 Elmer Rd., Unit 4
Patuxent River, MD 20670-1906

Telephone number:
DSN — 757-3614
Commercial — 301-757-3614

Telefax number:
DSN — 757-3410/3409
Commercial — 301-757-3410/3409

# APPENDIX B

TABLE B-II. AIR-4.4.5 petroleum testing laboratory

| Laboratory Shipping Address | Lab Mailing Address |
|---|---|
| Naval Air Station<br>Fuel Sample (AIR-4.4.5)<br>HAZMART, Bldg 2385<br>22680 Hammond Rd.<br>Patuxent River, MD 20670<br><br>Telephone:<br>DSN — 757-3417/3410/3409/3405<br>Commercial — 301-757-3417/3410/3409/3405<br><br>Telefax:<br>DSN — 757-3614<br>Commercial — 301-757-3614<br><br>UIC: N00421<br>Message Address: COMNAVAIRSYSCOM PATUXENT RIVER MD//4.4.5// | Commander<br>Naval Air Systems Command<br>AIR-4.4.5, Bldg 2360<br>22229 Elmer Rd., Unit 4<br>Patuxent River, MD 20670-1906 |

TABLE B-III. Naval Operational Logistics Support Center DC address

| |
|---|
| Director<br>NOLSC-DC<br>8725 John J. Kingman Rd., Suite 3719<br>Ft. Belvoir, VA 22060-6224<br><br>Telephone:<br>DSN — 427-7341/7328/7333<br>Commercial — 703-767-7341/7328/7333<br><br>Telefax:<br>DSN — 427-7389<br>Commercial — 703-767-7389 |

# APPENDIX C

# AIRCRAFT INFORMATION SUMMARIES

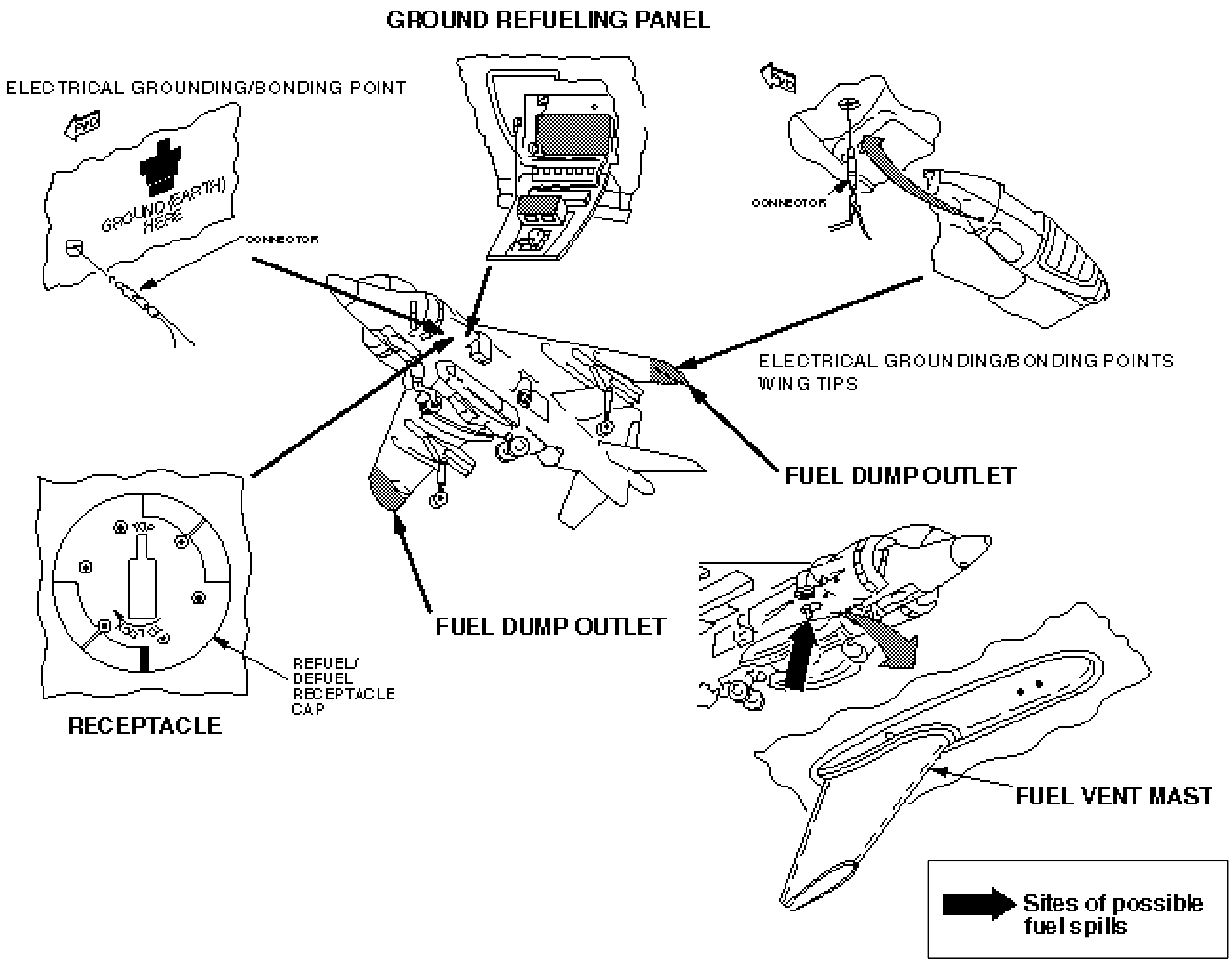
## C.1 SCOPE

C.1.1 Scope. This appendix provides general information about Navy and Marine Corps aircraft configurations, characteristics, and requirements that can impact aircraft refueling operations. This appendix has been assembled for use by fuel handling personnel for general planning and other purposes and is current as of the effective date of this handbook. The information has been extracted from specific aircraft NATOPS and maintenance manuals. Users of this handbook are advised to consult the specific aircraft NATOPS and maintenance manuals for the most accurate, up-to-date information.

## APPENDIX C

## AIRCRAFT: AV-8B

## AIRCRAFT CONFIGURATION



# APPENDIX C

## AIRCRAFT: AV-8B

TABLE OF FUEL CAPACITIES

| Tank | | | Gallons |
|---|---|---|---|
| Internal | Fuselage | Left Tank | 47 |
| | | Left Front | 80 |
| | | Right Front | 80 |
| | | Right Center | 47 |
| | | Rear | 162 |
| | Wing | Left | 362 |
| | | Right | 362 |
| | | Total Internal | 1,140 |
| External Tanks (Each) | | | 300 |
| Totals | With 2 External Tanks | | 1,720 |
| | With 4 External Tanks | | 2,328 |

### AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Wing Span Spread | 30 ft 4 in | Maximum Gross Weight — 21,500 lbs |
| Length | 46 ft 4 in | Maximum Footprint — 115 psi |
| Height | 11 ft 9 in | |

### AV-8B REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the AV-8B aircraft, primarily the operation of the “precheck” system. In addition to these specialized procedures, the applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

1. Remove receptacle cap and attach refueling nozzle.
2. Open door 22.
3. Press-to-test “TANK OVER PRESS” warning light on ground refueling panel for lamp operation.

## APPENDIX C

## AIRCRAFT: AV-8B

4. Set “LEFT” and “RIGHT REFUEL” switches on the ground refueling panel (door 22) to the “REFUEL” position (toggles down) and commence refueling.

5. Make sure “LEFT” and “RIGHT FUEL CONTENTS” lights are on.

**CAUTION**

If any of the three lamps fails to operate in steps 3 and 5 above, discontinue refueling operation immediately. System failure should be investigated and resolved before hot refueling can be accomplished.

6. Fuel can be stopped from entering the external tanks by setting “EXT TANK LOCKOUT” switch to “LOCKOUT” position.

7. Monitor the “TANK OVER PRESS” warning light.

**CAUTION**

Immediately stop fuel flow if “TANK OVER PRESS” indicator illuminates. “Hot refueling” cannot be performed on the aircraft until problem is resolved.

8. After 60 to 120 gallons of fuel have entered the aircraft's tanks, make sure air is venting from FUEL VENT MAST.

9. Watch the “LEFT” and “RIGHT FUEL CONTENTS” lights. When the lights go off, the aircraft is full. Immediately stop fuel flow and close and lock the nozzle's flow control handle.

10. Set “LEFT” and “RIGHT REFUEL” switches to flight position (toggles up).

**Note**

If any of the high level shut off valves fails to operate correctly, fuel will spill from the vent mast. Turn off fuel flow immediately!

**SPECIAL NOTES — AIRCRAFT FUEL SYSTEM**

1. This aircraft is NOT equipped with a precheck system.

2. Under normal conditions, all air being displaced by fuel in the tanks, including external tanks, exits the aircraft through the common “Fuel Vent Mast.”

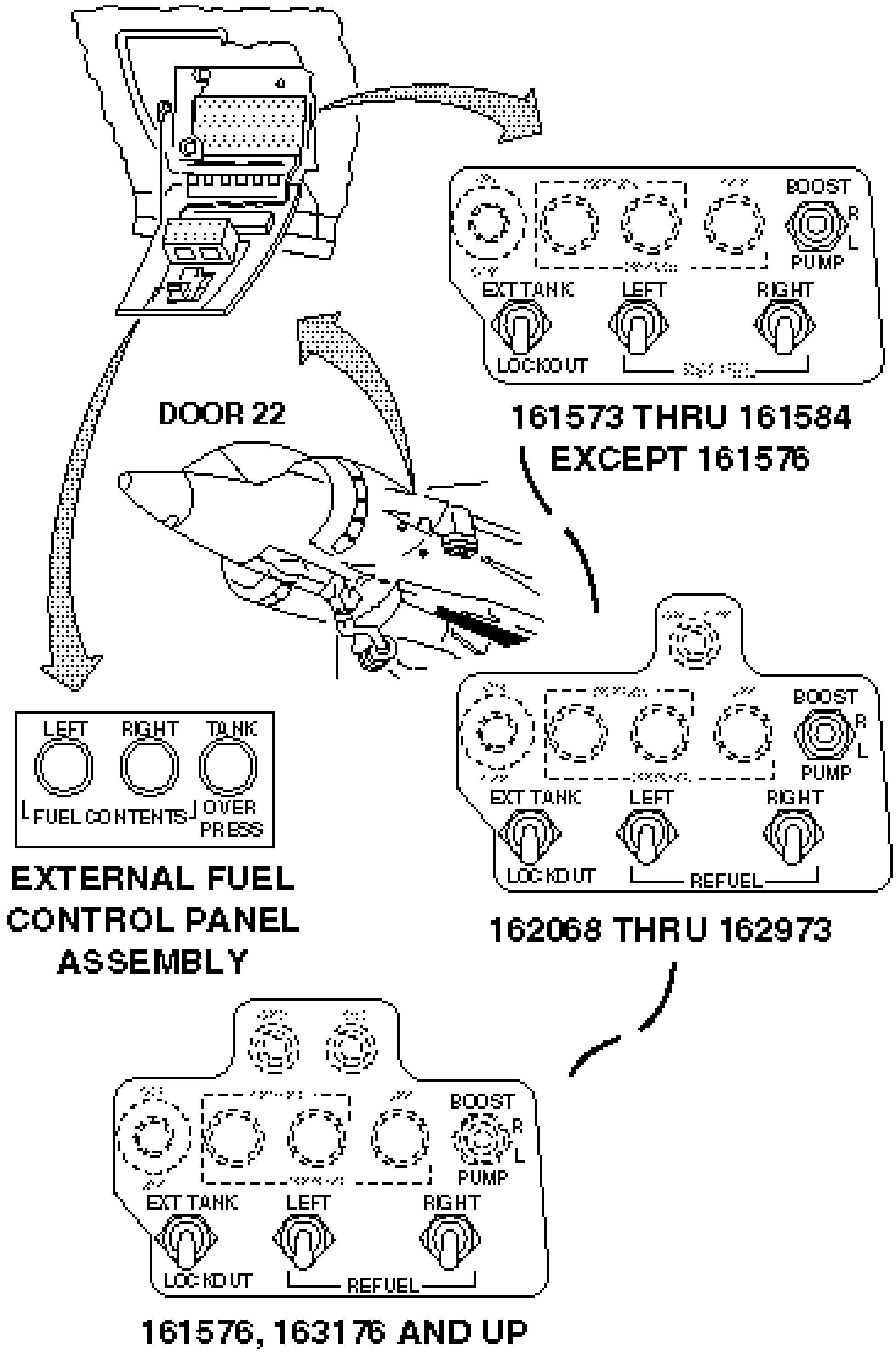
3. If any high level shut-off valves fails to operate correctly, fuel may spill from the “Fuel Vent Mast.”

4. A malfunction within an external fuel tank may cause fuel to spill from the bottom center of tank (pressure relief vent).

# APPENDIX C

# AIRCRAFT: AV-8B

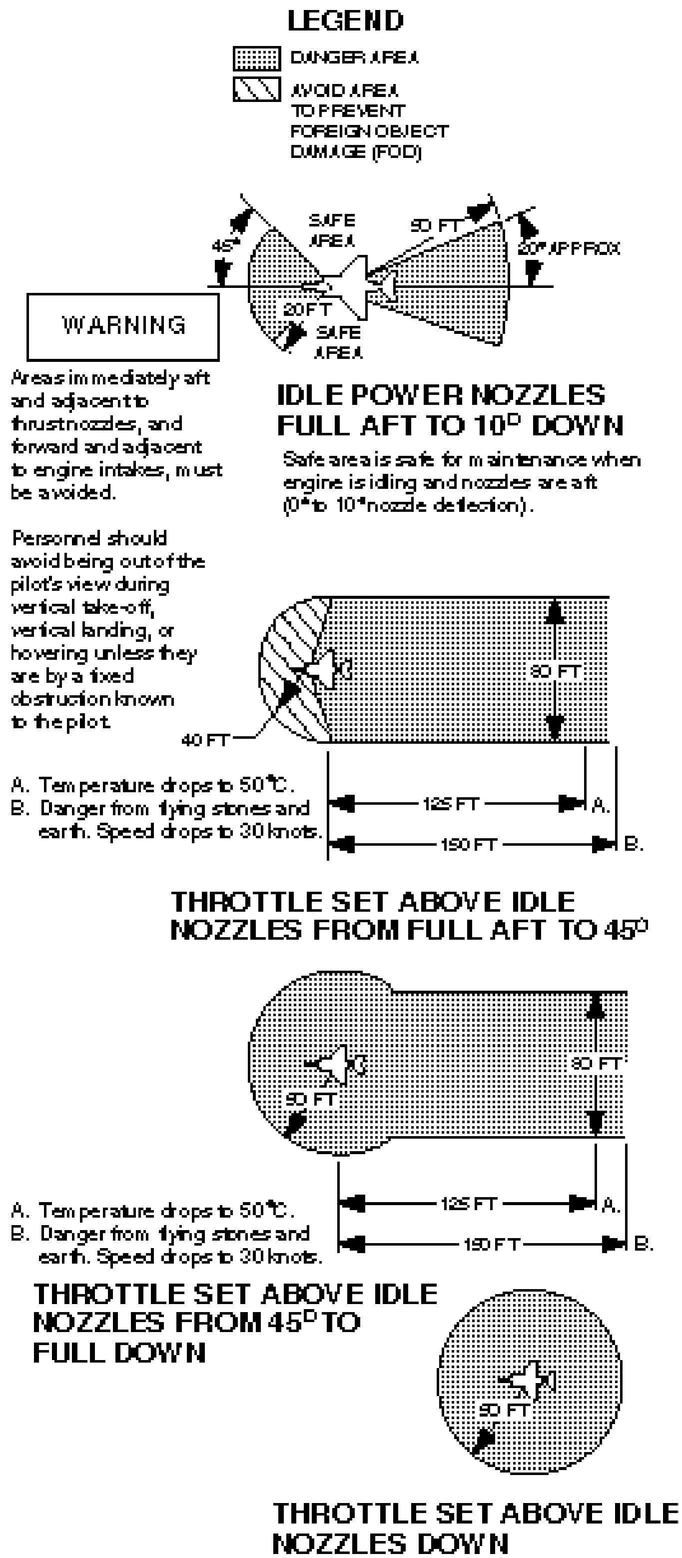
## GROUND REFUELING PANEL



# APPENDIX C

# AIRCRAFT: AV-8B

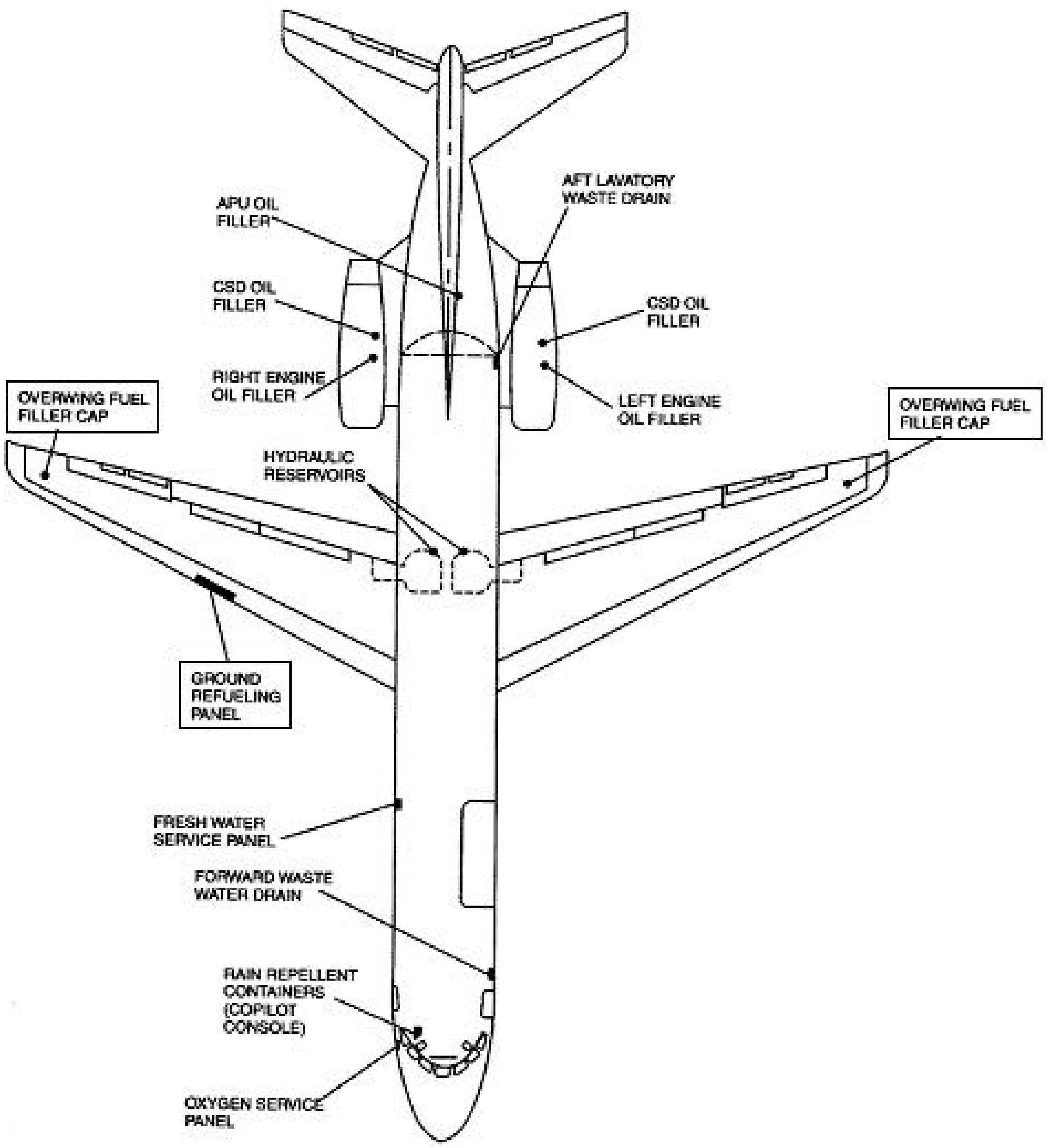
## PERSONNEL DANGER ZONES



# APPENDIX C

# AIRCRAFT: C-9

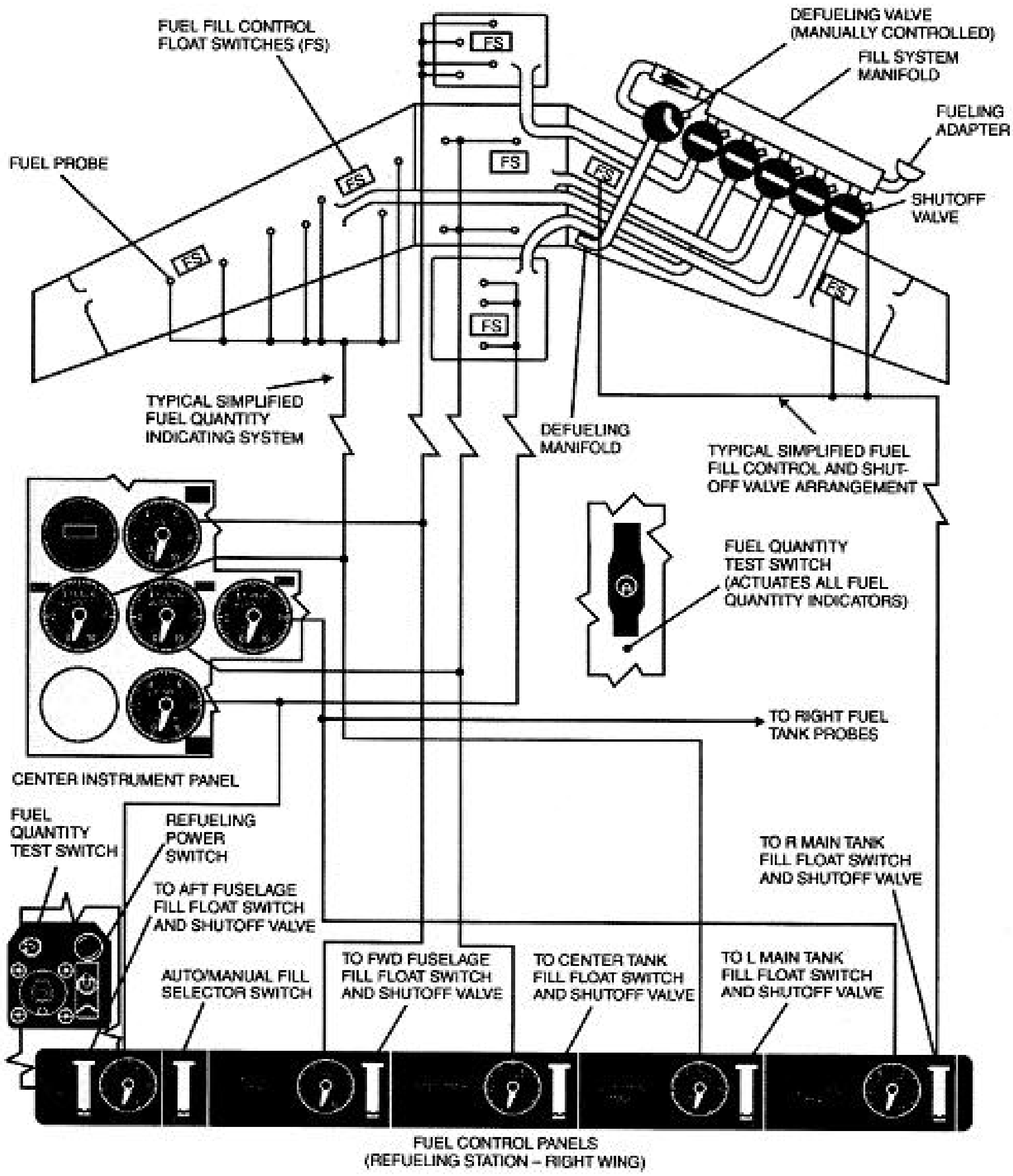
## AIRCRAFT CONFIGURATION



# APPENDIX C

## AIRCRAFT: C-9

### AIRCRAFT CONFIGURATION



# APPENDIX C

# AIRCRAFT: C-9

## TABLE OF FUEL CAPACITIES

| FUEL TANK | GALLONS |
|---|---|
| Left Main | 1,386 |
| Right Main | 1,386 |
| Center | 907 |
| FWD Fuselage | 1,250 |
| Aft Fuselage | 1,000 |
| TOTAL | 5,929 |

## AIRCRAFT CHARACTERISTICS

| AIRCRAFT DIMENSIONS | |
|---|---|
| Length | 119.3 ft |
| Height (top of vertical tail) | 27.5 ft |
| Height (top of fuselage) | 14.8 ft |
| Height (top of wing surface) | 7.3 ft |
| Wing Span | 93.3 ft |
| **WEIGHT (MAX GROSS)** | 111,000 lbs |

## C-9 REFUELING PROCEDURES

The following procedures are extracted from the C-9 NATOPS manual. In addition to these procedures, the applicable, basic refueling procedures contained in Chapter 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

1. **Pressure Fueling.** The aircraft fueling control panel is located in the right midwing leading edge, approximately 5-1/2 feet from ramp level. Access to the fuel control panel is through a forward swinging hinged access door located in the lower surface of the wing leading edge.

Pressure fueling can be accomplished with or without electrical power. Fuel flow, through the pressure-fueling adapter (manifold), is directed to independently operated left and right main, center, forward, and aft fuselage tank fuel fill valves. The fuel fill valves can be operated electrically or manually to control fuel flow through the individual tank fill lines.

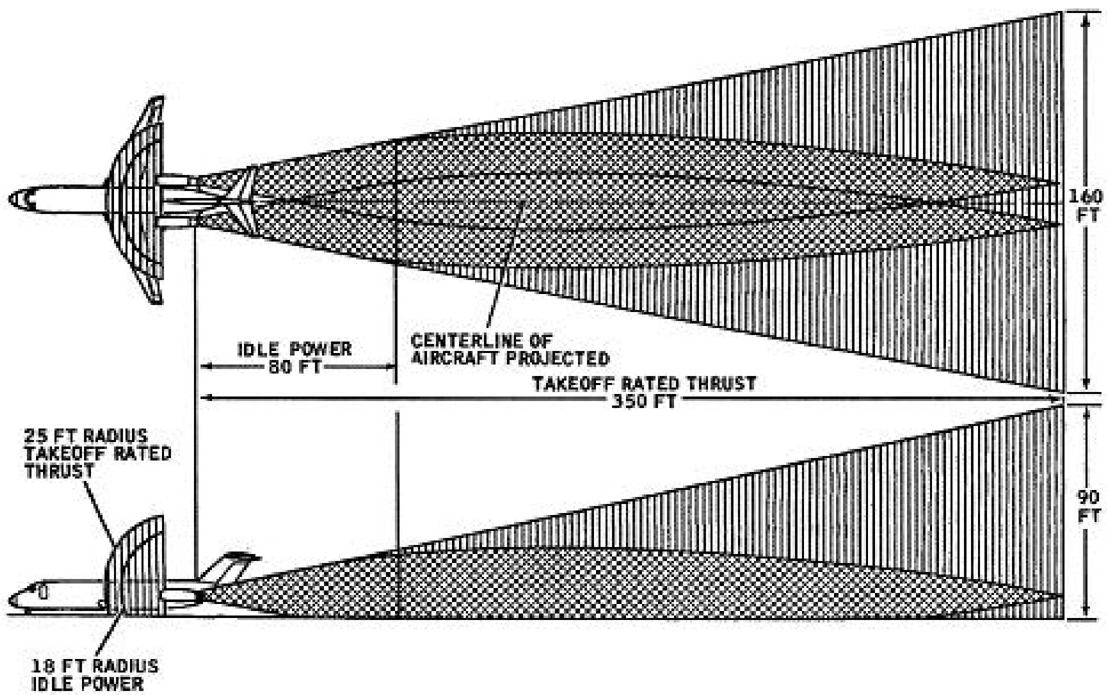
Fuel level control float switches, provided in each tank, automatically close the respective fuel fill valves when the tanks are full, provided electrical control is used. If nose gear strut is near the fully extended position, the oleo switch will be actuated and electrical power to fuel control panel will be off. When the tanks are being fueled to less than maximum capacity, the fuel fill valves should be closed individually, either electrically or manually, when the desired fuel load in each tank is attained. Fuel tank capacities and acceptable fuel specifications are shown on the fuel quantity data and fuel grade and limits charts.

2. **Gravity Fueling.** The left and right main fuel tanks can be gravity fueled through the overwing fill adapters located approximately 10 feet inboard of each wingtip. Procedures for gravity fueling the left and right main tanks are identical. The center, forward, and aft fuselage tank fueling is accomplished by using the right main tank boost pumps to pump fuel through the defueling line and fuel fill valve, and into the applicable tank fill line.

# APPENDIX C

# AIRCRAFT: C-9

## PERSONNEL DANGER ZONE




| DISTANCE BEHIND EXHAUST EXIT | | 75 FT | 100 FT | 200 FT | 350 FT |
|---|---|---|---|---|---|
| AT START OF TAXI ROLL | BLAST PRESSURE-PSF | 18 | 8 | 3 | 2 |
| | VELOCITY-KNOTS | 75 | 50 | 30 | 20 |
| | TEMPERATURE RISE (1) | 50° F<br>28° C | 30° F<br>17° C | 5° F<br>3° C | |
| AT IDLE POWER | VELOCITY-KNOTS | 40 | 25 | 20 | 10 |
| | TEMPERATURE RISE (1) | 30° F<br>17° C | 10° F<br>6° C | 5° F<br>3° C | |
| AT TAKEOFF RATED THRUST | VELOCITY-KNOTS | 165 | 125 | 60 | 36 |
| | TEMPERATURE RISE (1) | 90° F<br>50° C | 70° F<br>39° C | 20° F<br>11° C | 20° F<br>11° C |

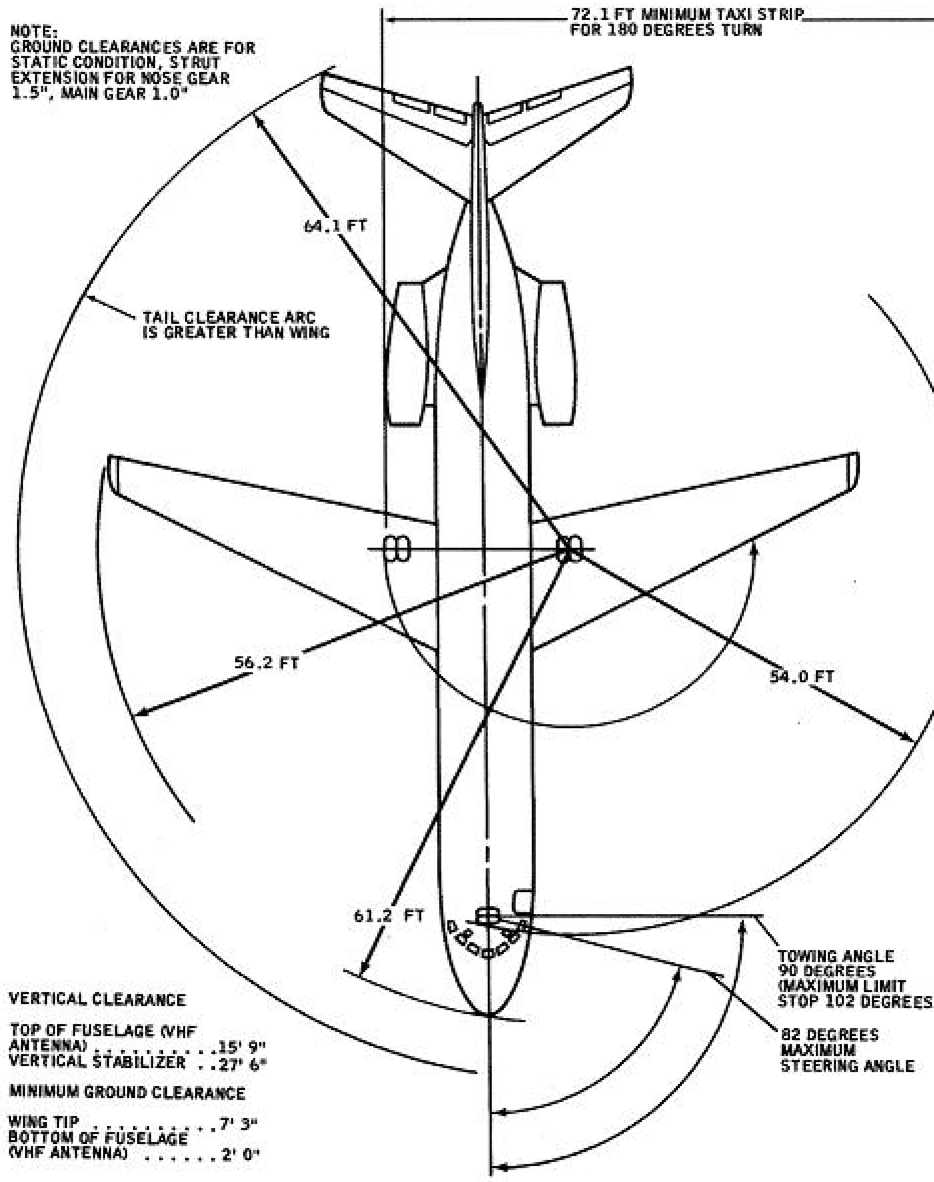
NOTE:
(1) TEMPERATURES ARE ABOVE AMBIENT CONDITIONS.

# APPENDIX C

## AIRCRAFT: C-9

PERSONNEL DANGER ZONE

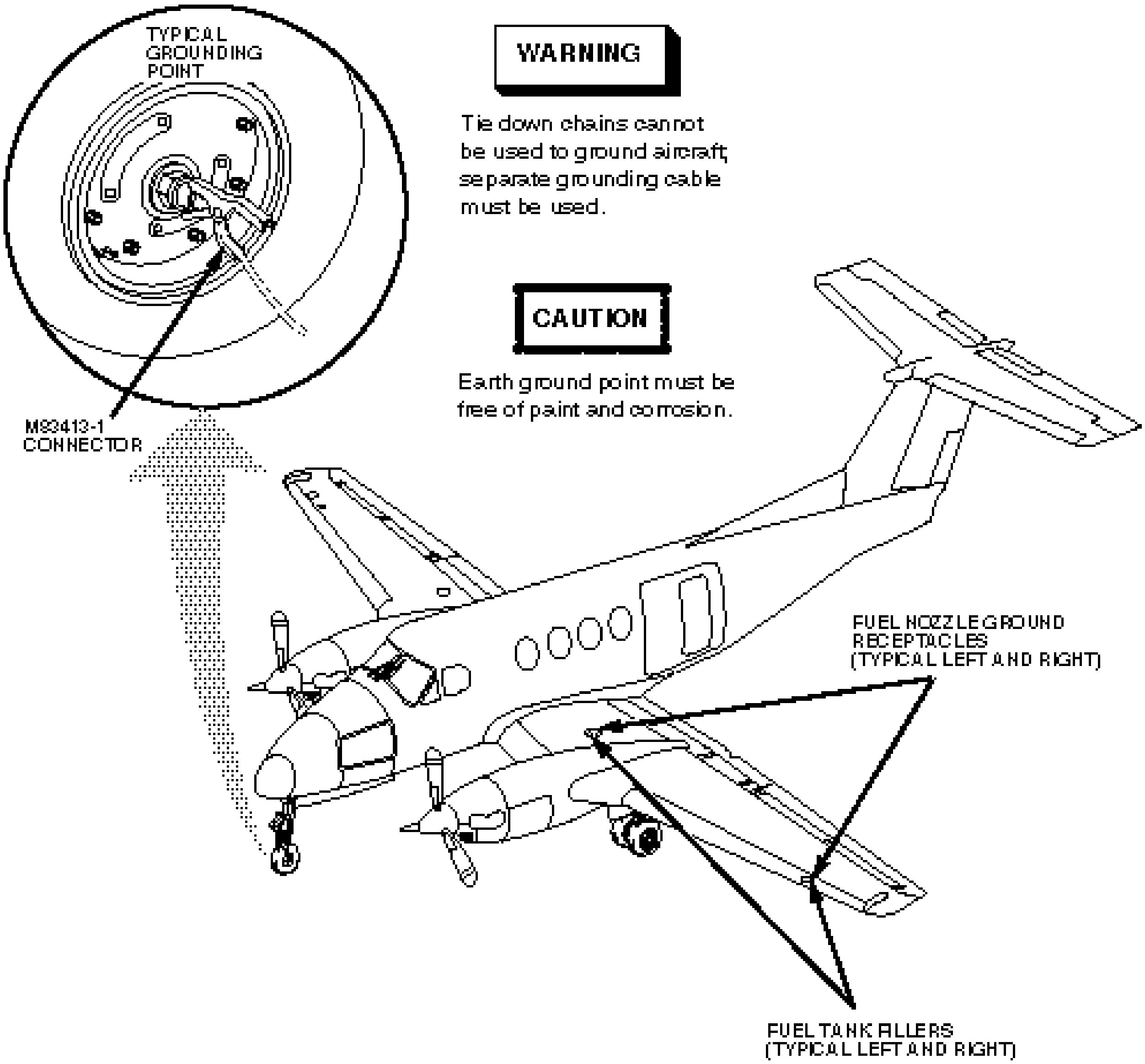
MINIMUM TURNING RADIUS



# APPENDIX C

# AIRCRAFT: C-12

## AIRCRAFT CONFIGURATION



# APPENDIX C

# AIRCRAFT: C-12

### TABLE OF FUEL CAPACITIES

| Tank | Gallons |
|---|---|
| Wing & Nacelle | 195.0 |
| Auxiliary | 79.5 |
| Total Useable | 544.0 |
| Total Capacity | 549.0 |

### AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Wing Span | 54 ft 6 in | Maximum Gross Weight — 13,500 lbs |
| Length | 43 ft 10 in | Maximum Footprint — 64 psi |
| Height | 14 ft 6 in | |

## C-12 REFUELING PROCEDURES

The C-12 aircraft does not have a single point refueling adapter and, therefore, can only be gravity refueled.

### GRAVITY FUELING

1. Attach bonding cables to aircraft.
2. Attach bonding cable from hose nozzle to ground.
3. Open applicable fuel tank filler cap.

**CAUTION**

Do not insert fuel nozzle completely into fuel cell because of possible damage to bottom of fuel cell.

4. Fill fuel tank with fuel.
5. Secure applicable fuel tank filler cap.

**CAUTION**

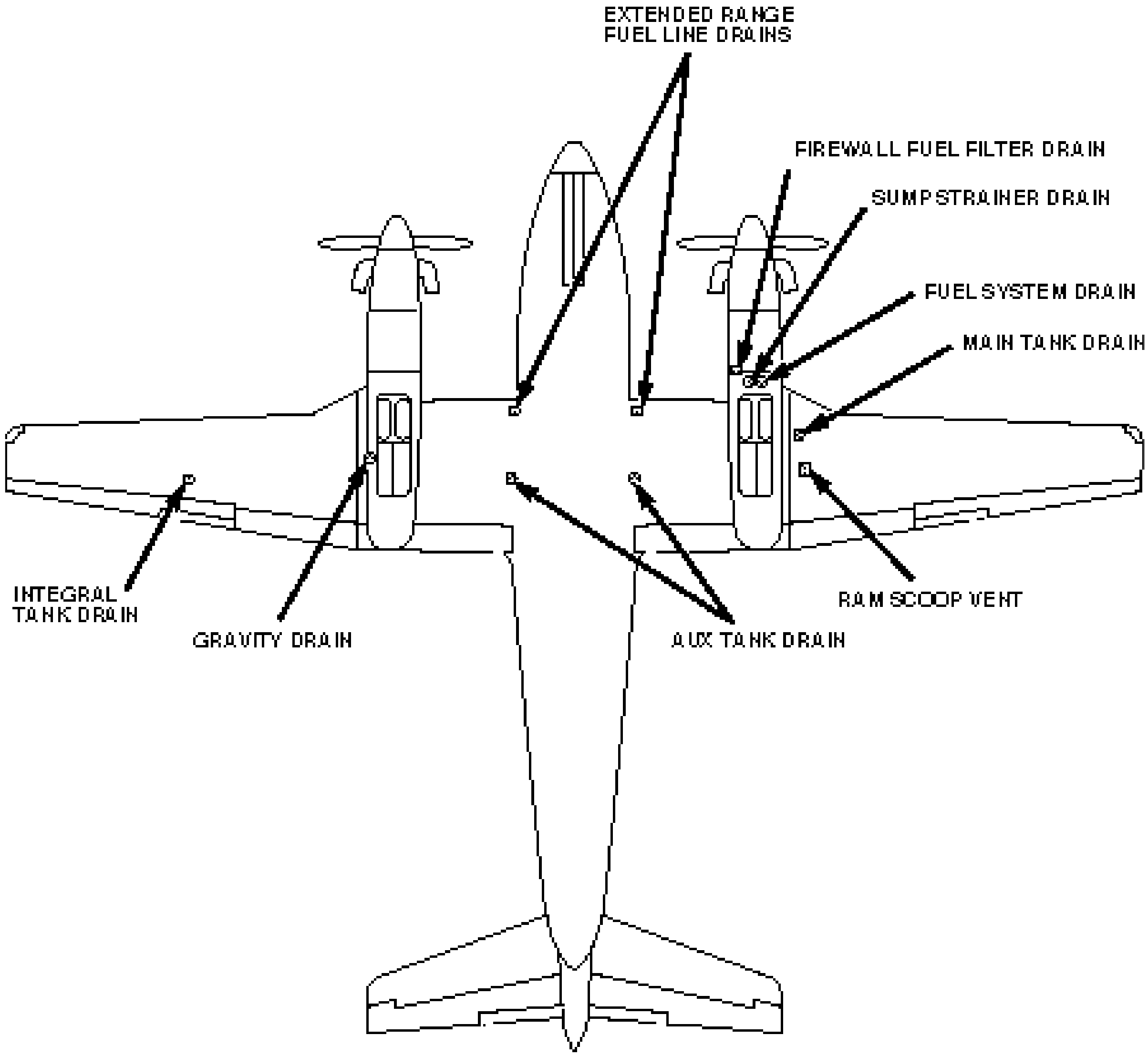
Make sure latch-tab on cap is pointed aft.

6. Disconnect bonding cables from aircraft.

# APPENDIX C

# AIRCRAFT: C-12

DRAINS AND VENTS



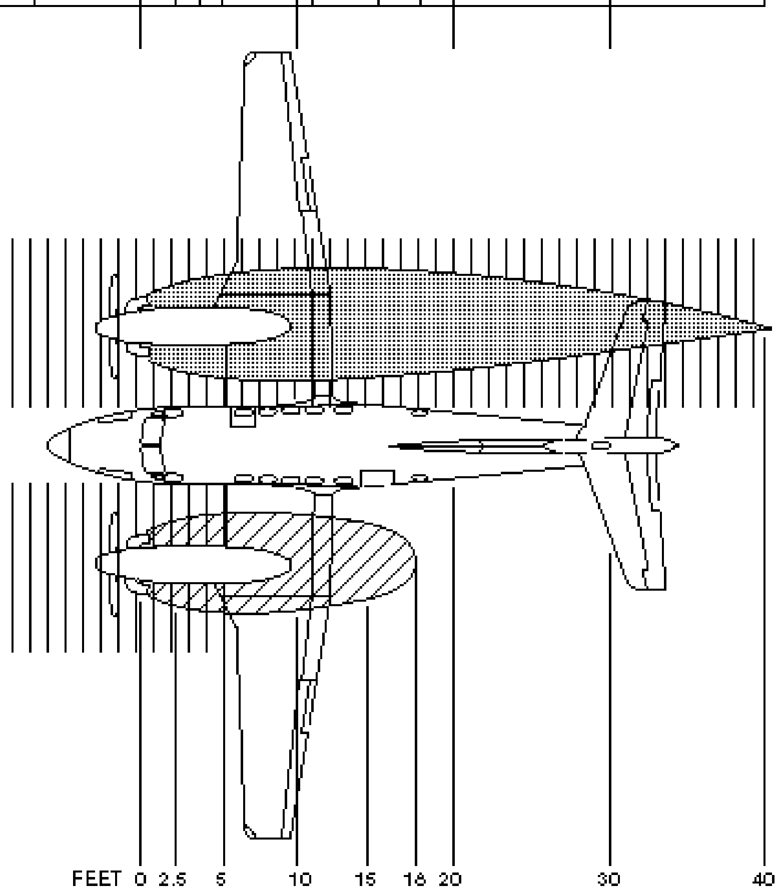

BOTTOM VIEW

# APPENDIX C

# AIRCRAFT: C-12

PERSONNEL DANGER ZONE

| | | | | | |
|---|---|---|---|---|---|
| MILITARY THRUST | VELOCITY KNOTS | 655 250 150 | 75 50 43 | | |
| | TEMP F | 1099 600 450 | 250 174 160 | | |




**LEGEND**

- EXHAUST DANGER AREAS (GROUND IDLE)
- EXHAUST DANGER AREAS (MAX POWER)
- PROPELLER DANGER AREA

**NOTE**

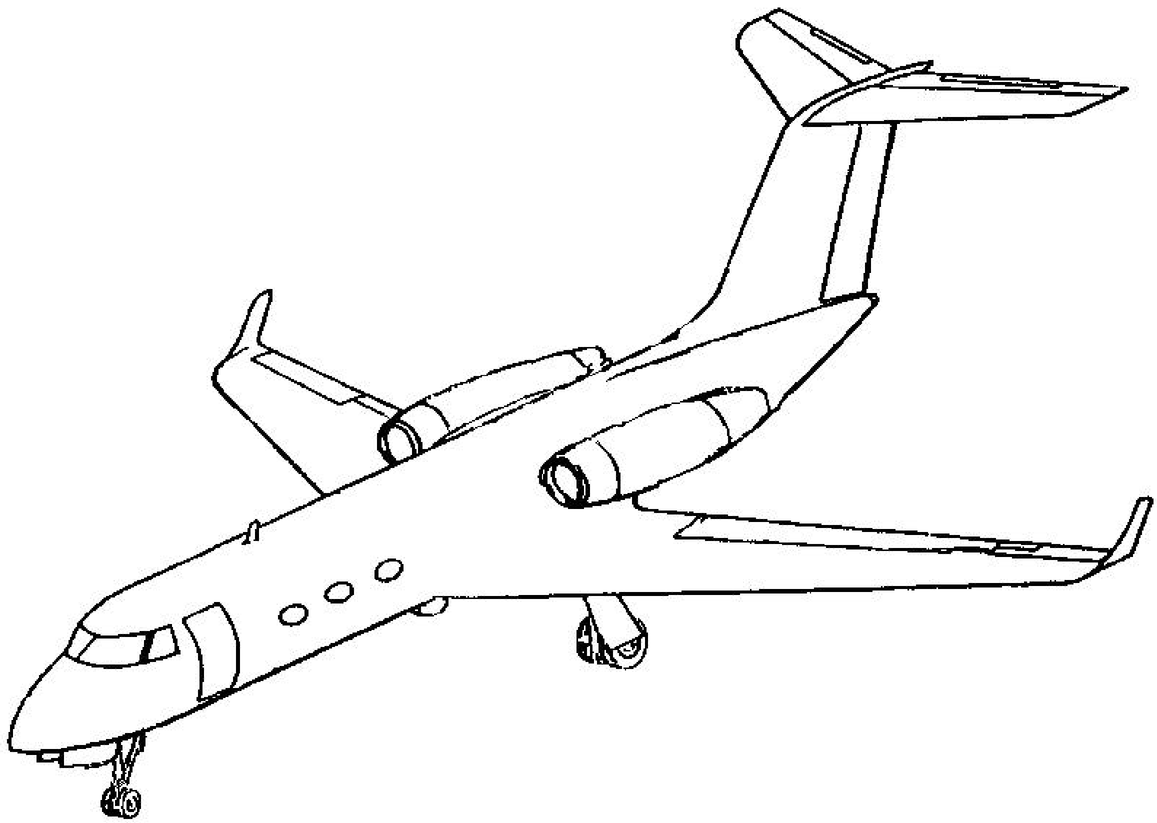
- The exhaust danger area does not include propeller wake, which increases velocity and significantly reduces temperature.
- Exhaust gas temperature and velocity at ground idle are very low, however, the immediate area of exhaust discharge should be avoided.

# APPENDIX C

# AIRCRAFT: C-20

## GENERAL

There are two versions of the C-20 in Navy service: the C-20D and the C-20G.  Both aircraft are outwardly similar and have similar fuel systems.  Differences are noted where appropriate.



# APPENDIX C

# AIRCRAFT: C-20

## TABLE OF FUEL CAPACITIES

| TANK | GALLONS |
|---|---|
| **C-20D**: Left | 2,096 |
| Right | 2,096 |
| Total | 4,192 |
| **C-20G**: Left | 2,185 |
| Right | 2,185 |
| Total | 4,370 |

## AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Length (overall) | | Maximum Gross Takeoff: |
| C-20D | 83 ft 2 in | C-20D – 69,700 lbs |
| C-20G | 88 ft 4 in | C-20G – 73,200 lbs |
| Height (to top of tail) C-20D | 24 ft 6 in | Maximum Gross Ramp: |
| C-20G | 24 ft 5-1/8 in | C-20D – 70,200 lbs |
| | | C-20G – 73,600 lbs |
| Wingspan | 77 ft 10 in | |

## C-20 REFUELING PROCEDURES

**Location of Refueling Adapters:**

Pressure refueling adapter: Right Hand Wing Fillet Leading Edge
Gravity refueling adapters: Upper Skin of Each Outer Wing

**Location of Bonding/Grounding Jack**: Leading Edge of Each Wing

The following procedures are extracted from the C-20 D and G NATOPS manuals. In addition to these procedures, the applicable, basic refueling procedures contained in Chapter 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

# APPENDIX C

# AIRCRAFT: C-20

## 1. Gravity Fueling

### a. C-20D

A fuel filler cap and adapter assembly is located in the upper skin of each outer wing. The adapter has a standpipe filler neck that limits a wing tank capacity to approximately 2,067 gallons.

A grounding jack, located in the wing leading edge, is provided so that the fueling nozzle may be grounded during fueling.

**Note**

It is recommended that fueling be accomplished over the leading edge of the wing, rather than the trailing edge in order to prevent damage to the aileron.

If full fuel capacity is required when gravity fueling, it will be necessary to remove the inboard vent cover which is located on the lower skin, BL 26.

During gravity fueling, the fuel is allowed to run inboard, through the ribs, to the centerline. The tank is then filled from the centerline rib, including the hopper, outboard.

### b. C-20G

A fuel filler cap and adapter assembly is located in the upper skin of each outer wing. The adapter has a standpipe filler neck that limits a wing tank capacity to approximately 2,185 gallons.

A grounding jack, located in the wing leading edge, is provided so that the fueling nozzle may be grounded during fueling.

**CAUTION**

It is recommended that fueling be accomplished over the leading edge of the wing, rather than the trailing edge to prevent damage to control surfaces.

During gravity fueling, the fuel is allowed to run inboard through the ribs to the centerline. The tank is then filled from the centerline rib, including the hopper, outboard.

Perform overwing refueling as follows:

1. Check quantity in tanks using cockpit standby gauges.
2. Check that main vent on lower surface of wing is open.
3. Remove gravity filler cap from adapter at outboard location, upper skin surface.
4. Ground fuel nozzle to aircraft structure through grounding jack located in the upper leading edge.
5. Fuel as required.
6. When fueling has been completed, replace filler cap and check for security.

# APPENDIX C

# AIRCRAFT: C-20

## 2. Pressure Fueling

### a. C-20D

The aircraft can be refueled from a single point manifold located in the RH wing/fuselage fillet leading edge. The system is a hydromechanical system, with capability for cockpit or filler station intermediate shut off. During normal single-point refueling conditions, fuel enters the Pressure Fueling Adapter (figure 2-21). The fuel proceeds through the main fill line to a cross fitting. A directional check valve located downstream of the straight-through portion of the cross fitting stops flow into the RH hopper while fuel continues to flow through the arms of the cross fitting and through the LH and RH fill lines to the shutoff valves. The shutoff, when fueling to capacity, is controlled by a fluid force differential on the shutoff poppet. As fuel tills the cavity, the air is vented and expelled overboard through the vent lines. As the fuel level nears capacity, the float in the hi-level pilot rises and, by means of mechanical linkages, closes the shutoff poppet, Fuel coming into this line from the downstream side of the shutoff valve poppet increases in pressure until the valve closes. Two two-position rocker switches labeled REMOTE FUELING SHUTOFF switches (figure 2-22) are located on the Overhead Control Panel which allow shutting off of fuel to a particular tank when selected. When the switches are selected to the CLOSED position, the left and right fueling valves are closed and fueling is shut off. Fuel can also be shutoff by manually operating the pre-check selector valves. Power for operation of the Remote Fueling Shutoff Valves and switches is from Essential 28 VDC Bus, through two circuit breakers labeled L and R FUELING S/O (Hl, H2) on the Pilot’s Circuit Breaker Panel.

**WARNING**

When refueling on a significant side slope, the fuel gaging system is inaccurate and considerable fuel unbalance may occur. To preclude fuel unbalance, determine the proper amount of gallons/liters/etc to upload for each tank. Then, refuel one tank at a time using the truck gages to determine proper upload.

**CAUTION**

When Remote Fueling Shutoff switches are used to terminate fueling, the fueling nozzle should be removed prior to either placing the Remote Fueling Shutoff Switches to OPEN or removing power. Pressure from the refueling vehicle should be 35-55 psi for proper operation of the shutoff valves.

**CAUTION**

Empennage damage may occur if aft tail compartment ladder is down and pinned during fuel servicing.

**Pressure fueling pre-check valves**. The pressure fueling pre-check valves (figure 2-21) are located on the pressure fueling adapter. The purpose of these valves, one for each tank, is to check the shutoff operation due to actuation of the tank pressure sense valve and the hi-level pilot. Operation of the pre-check valves is identical for the left hand and right hand sides. As fuel enters the pressure fueling adapter, the position of the pre-check selector should be on fuel. Selecting press allows some fuel to flow through the selector valve to the tank pressure sense valve entering the valve on the tank side of the diaphragm. This operation simulates a

## APPENDIX C

## AIRCRAFT: C-20

buildup of tank pressure acting on the diaphragm against the ambient pressure and results in a fuel shut-off to the affected tank. If the float position is selected, fuel is diverted to the hi-level pilot. The fuel enters the float cage at a much faster rate than it is allowed to bleed off, causing the float to rise and simulating a full tank capacity which closes the poppet. This simulates the normal operation of the fuel shutoff valve to the particular tank. The procedure is shown on figure 2-23.

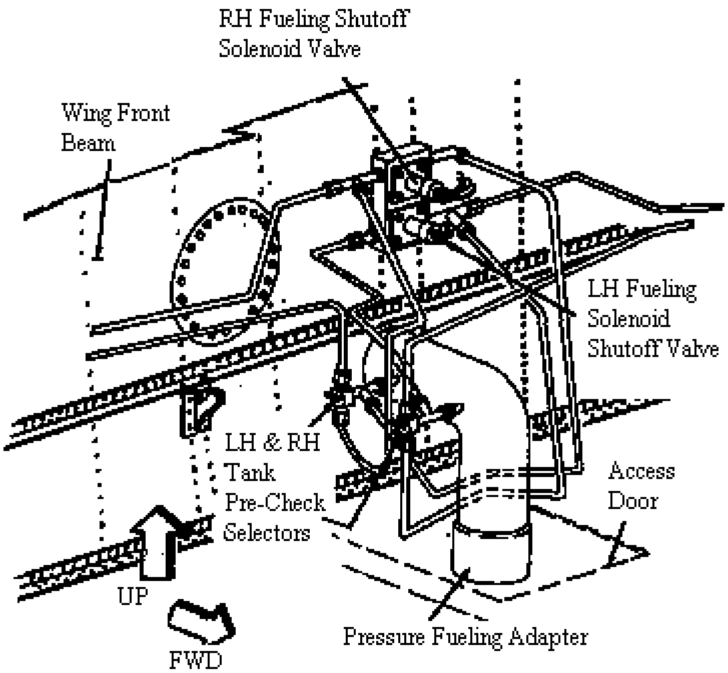
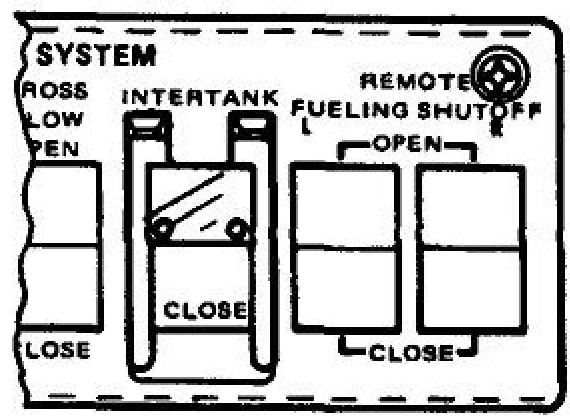



Fig 2-21: Pressure Fueling Adapter




Located on Overhead Control Panel

Fig 2-22: Remote Fueling Shutoff Switches

# APPENDIX C

# AIRCRAFT: C-20

| Procedure | PRESSURE FUELING PRECHECK VALVES | |
|---|---|---|
| | LH TANK | RH TANK |
| a) Check Precheck selectors are in FUEL and fuel is flowing | FUEL | FUEL |
| b) Position both LH Tank & RH Tank selectors to FLOAT. Fueling should stop. | FLOAT | FLOAT |
| c) Position RH Tank selector to PRESS. Fuel may start to flow as the selector passes FUEL and should stop again. | FLOAT | PRESS |
| d) Reposition RH Tank selector to FLOAT. Fuel may start to flow as the selector passes FUEL and should stop | FLOAT | FLOAT |
| e) Position LH Tank selector to PRESS. Fuel may start to flow as the selector passes FUEL and should stop again. | PRESS | FLOAT |
| f) Return the LH Tank & RH Tank selectors to FUEL and continue fueling. | FUEL | FUEL |

**CAUTION** **IF DURING THIS PROCEDURE FUEL FLOW INTO THE TANK DOES NOT STOP WHEN INDICATED, TERMINATE FUELING AT THE NOZZLE AND TROUBLESHOOT.**

Fig 2-23: Pressure fueling precheck valve check procedure

### b. C-20G

The single-point pressure fueling system is a hydromechanical system, with capability for cockpit (through the solenoid valve) or filler station (manual) immediate shutoff.

During normal pressure fueling conditions, fuel enters the pressure fueling adapter, which is located in the leading edge of the right wing/ fuselage fillet. The fuel proceeds through the main till line to a cross fitting. A directional check valve located downstream of the straight-through portion of the cross fitting stops flow into the right hopper while fuel continues to flow through the arms of the cross fitting and through the left and right till lines, the shutoff valves, and into the tanks.

When the fuel level rises enough to close the outboard high-level pilot valves, pressure-sensing lines divert fuel pressure to the downstream side of the shutoff valve poppets, causing the shutoff valves to close and fuel to stop entering the wings.

Pressure fueling precheck valves are located on the pressure fueling adapter. The purpose of these valves, one for each tank, is to check the shutoff operation due to actuation of the tank pressure sensing valve and the high-level pilot valve. The valves can be used to drive the shutoff valves to the closed position, thereby shutting off fuel to the respective tank.

Pressure fueling may also be terminated from the cockpit by using the L and/or R REMOTE FUELING SHUTOFF switches (Figure 3-2) on the overhead panel.
These switches, when positioned to CLOSED, energize the fuel shutoff solenoid valves located above the pressure fueling adapter, terminating the pressure fueling operation.

**Note**

Pressure from the refueling vehicle should be 35-55 psi for proper operation of the shutoff valves.

#### Full Capacity Pressure Fueling

1. Gain access to pressure fueling adapter through access door located in the fillet between the fuselage and right wing.

2. Remove dust cover from adapter.

3. Ground pressure fueling nozzle.

4. Connect pressure fueling nozzle to pressure fueling adapter.

5. Check that precheck selectors, mounted to pressure fueling adapter, are in FUEL position.

6. Open pressure fueling nozzle.

7. Perform prechecks during refueling operation as follows:

    a. Check that precheck selectors are in FUEL and fuel is flowing.
    b. Position both LH tank and RH tank selectors to FLOAT. Fueling should stop.
    c. Position RH tank selector to PRESS. Fuel may start to flow as the selector passes FUEL and should again stop.
    d. Reposition RH tank selector to FLOAT. Fuel may start to flow as the selector passes FUEL and should again stop.

# APPENDIX C

# AIRCRAFT: C-20

   e. Position LH tank selector to PRESS. Fuel may start to flow as the selector passes FUEL and should again stop.
   f. Return the LH tank and RH tank selectors to FUEL and continue fueling.

8. After completion of the precheck procedures, perform a functional check of the pressure fueling shutoff from the cockpit as follows:

   a. Make sure that the L and R REMOTE FUELING SHUTOFF switches are in the OPEN position.
   b. Energize the essential 28-vdc bus.
   c. Place the L SHUTOFF switch to the CLOSED position. Fueling to the left tank should terminate.
   d. Place the L SHUTOFF switch to the OPEN position. Fuel to the left tank should start to flow.
   e. Place the R SHUTOFF switch to the CLOSED position. Fueling to the right tank should terminate.
   f. Place the R SHUTOFF switch to the OPEN position. Fuel to the right tank should start to flow.
   g. De-energize the essential 28-vdc bus.

9. Fueling will terminate automatically by operation of the high-level shutoff pilot valve.

10. Close pressure fueling nozzle.

11. Remove pressure fueling nozzle from pressure fueling adapter.

12. Remove ground.

13. Replace dust cover on pressure fueling adapter and check for security.

14. Close access door.

**Partial Loading Pressure Fueling**

1. Gain access to pressure fueling adapter through access door located in the fillet between the fuselage and right wing.

2. Remove dust cover from adapter.

3. Ground pressure fueling nozzle.

4. Connect pressure fueling nozzle to the pressure fueling adapter.

5. Check that precheck selectors, mounted to pressure fueling adapter, are in FUEL position.

6. Make sure that the L and R REMOTE FUELING SHUTOFF switches (located in the overhead panel) are in the OPEN position.

7. Open pressure fueling nozzle.

8. Perform prechecks during refueling operation.

**Note**

- Steps 9 through 11 cover partial loading using the precheck selector at the pressure fueling adapter.

- Steps 12 through 17 cover partial loading using the remote fueling shutoff switches.

9. When the required amount of fuel has been uplifted to one side, place the precheck selector for that tank to the FLOAT position.

10. When the required amount of fuel has been uplifted into the other side, close the pressure fueling nozzle.

# APPENDIX C

# AIRCRAFT: C-20

11. Reposition selector valve from FLOAT (step 9) to FUEL.

12. Energize the essential 28-vdc bus.

13. When the required amount of fuel has been uplifted into one side, place the REMOTE FUELING SHUTOFF switch for that tank to the CLOSED position.

14. When the required amount of fuel has been uplifted into the other side, place the other REMOTE FUELING SHUTOFF switch to the CLOSED position.

15. Close the pressure fueling nozzle.

16. Place the REMOTE FUELING SHUTOFF switches to the OPEN position.

17. De-energize the essential 28-vdc bus.

18. Remove pressure fueling nozzle from pressure fueling adapter.

19. Remove ground.

20. Replace dust cover from pressure fueling adapter and check for security.

21. Check that precheck selectors are in FUEL position.

22. Close access door.

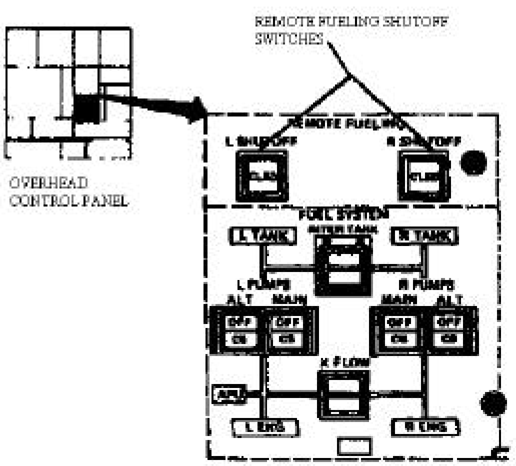



Fig 3-2: Remote Fueling Shutoff Switches

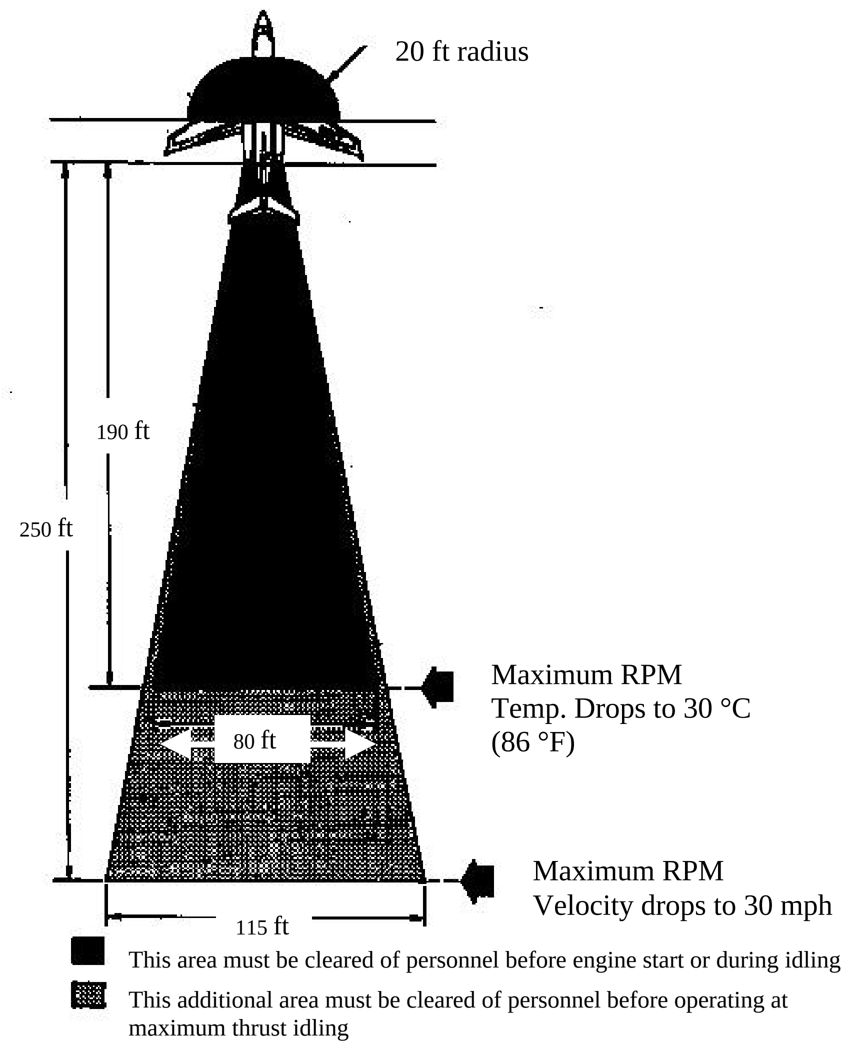
# APPENDIX C

# AIRCRAFT: C-20

## PERSONNEL DANGER ZONES

### 1. C-20D

**Engine**



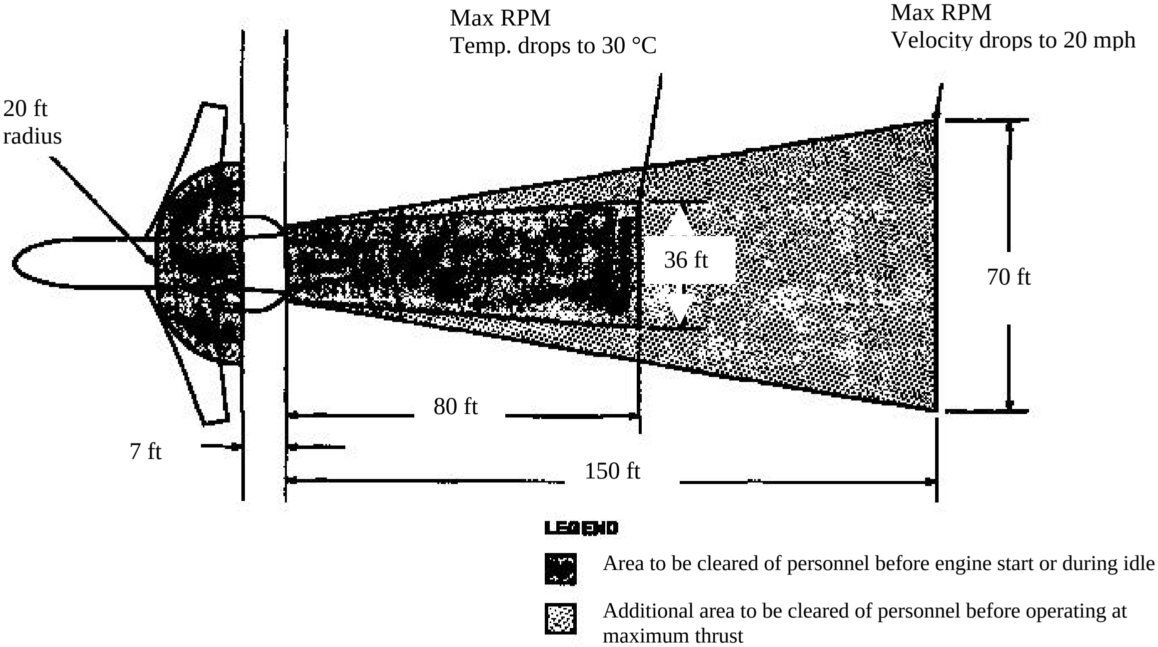

**APU –** see C-20G

## APPENDIX C

## AIRCRAFT: C-20

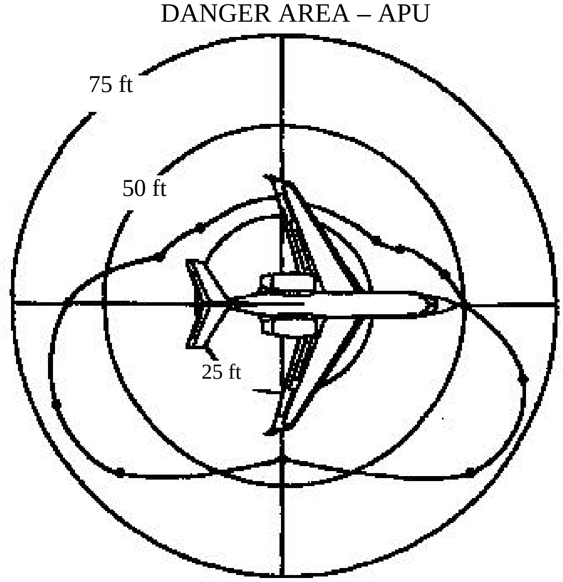
**2. C-20G**

**Engine**




**APU**

DANGER AREA – APU

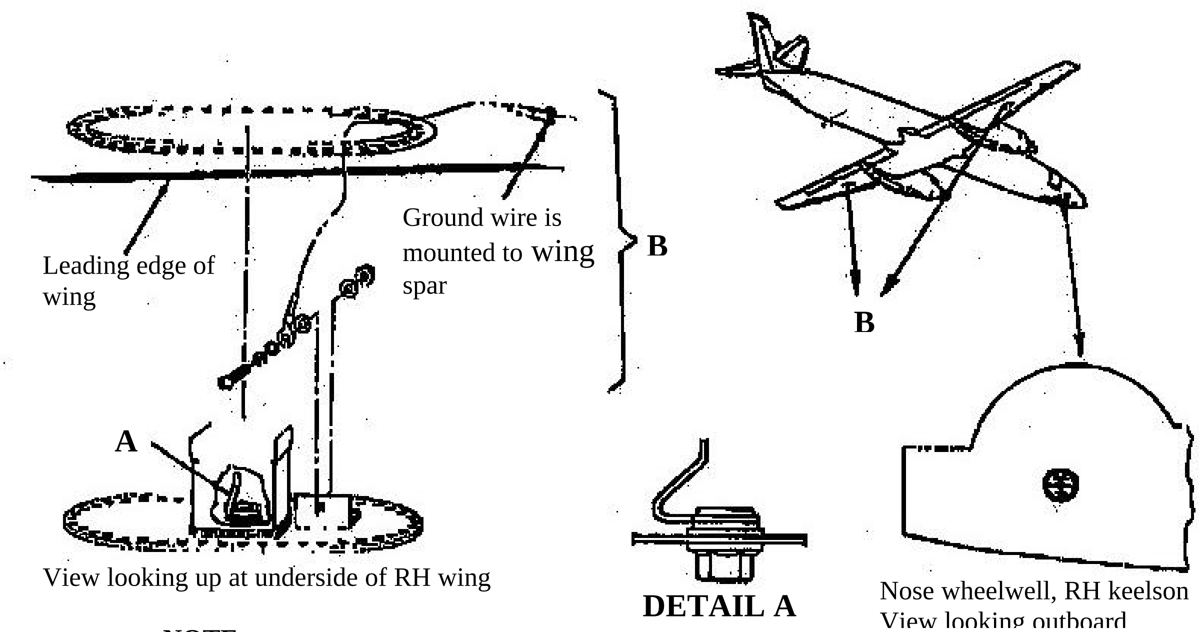



TWO HOUR NOISE EXPOSURE BOUNDARY (92 DB(A)) – NO HEARING PROTECTION. APU OPERATING ONLY. NOTE – NO RESTRICTION IF EAR PLUGS ARE USED.

# APPENDIX C

# AIRCRAFT: C-26

## AIRCRAFT GROUNDING/BONDING POINTS




**NOTE**

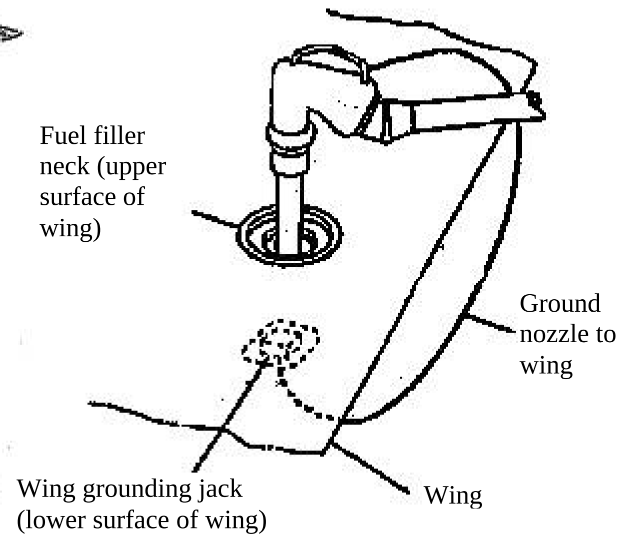
**Connect overwing refueling nozzle bonding plug to underwing grounding receptacle prior to initiating refueling**

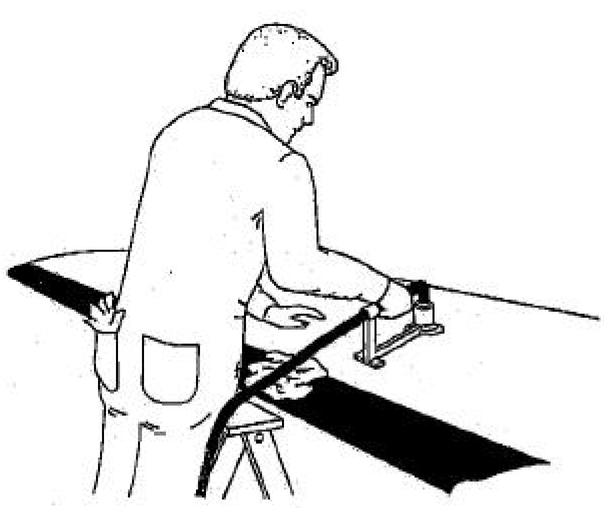
# APPENDIX C

# AIRCRAFT: C-26

## C-26 Refueling Procedures

The C-26 aircraft is designed for overwing (gravity) refueling with one fuel cap on the upper surface of each wing. No provisions for single-point (pressure) refueling are provided. Use a small stepladder to access the refueling receptacle. Bring the refueling hose over the leading edge of the wing being careful to protect the wing deicing boot on the wing leading edge.



**CAUTION**

DO NOT ALLOW AFT PORTION OF FUEL NOZZLE OR HOSE TO REST ON DEICE BOOT. THE DEICE BOOTS ARE MADE OF SOFT, FLEXIBLE, SYNTHETIC RUBBER WHICH MAY BE DAMAGED IF HOSES ARE DRAGGED OVER THE SURFACE OR IF LADDERS AND PLATFORMS ARE RESTED AGAINST THEM.

# APPENDIX C

# AIRCRAFT: C-26

## REFUELING PROCEDURES

Usable fuel capacity is 324 US gallons per wing (646 gallons total). The fuel quantity gauge compensates for fuel density and reads tank quantity in pounds.

NOTE

On a sloping ramp, the uphill tank may not accept a full fuel load if the downhill wing tank is filled first. When refueling on a sloping ramp, the uphill tank can be filled to maximum capacity by refilling both tanks simultaneously, by refilling the uphill wing tank first, or by adding fuel to the wings alternately in approximately 125 gallon increments. When less than maximum capacity is required, this special fueling procedure is not necessary.

When filling the wing tanks to maximum capacity under all conditions, expect the tanks to accept the last 20 or 30 gallons at a slower rate because the last of the fuel requires extra time to travel to all of the fuel bays.

After fuel tanks are serviced, remove fuel nozzle before disconnecting ground.

Ensure tank caps are securely seated and locked (latch facing aft).

# APPENDIX C

## AIRCRAFT: C-37

The C-37 is the Navy version of the Gulfstream G V corporate jet aircraft. For refueling procedures, refer to the C-37 (G V) flight manual.

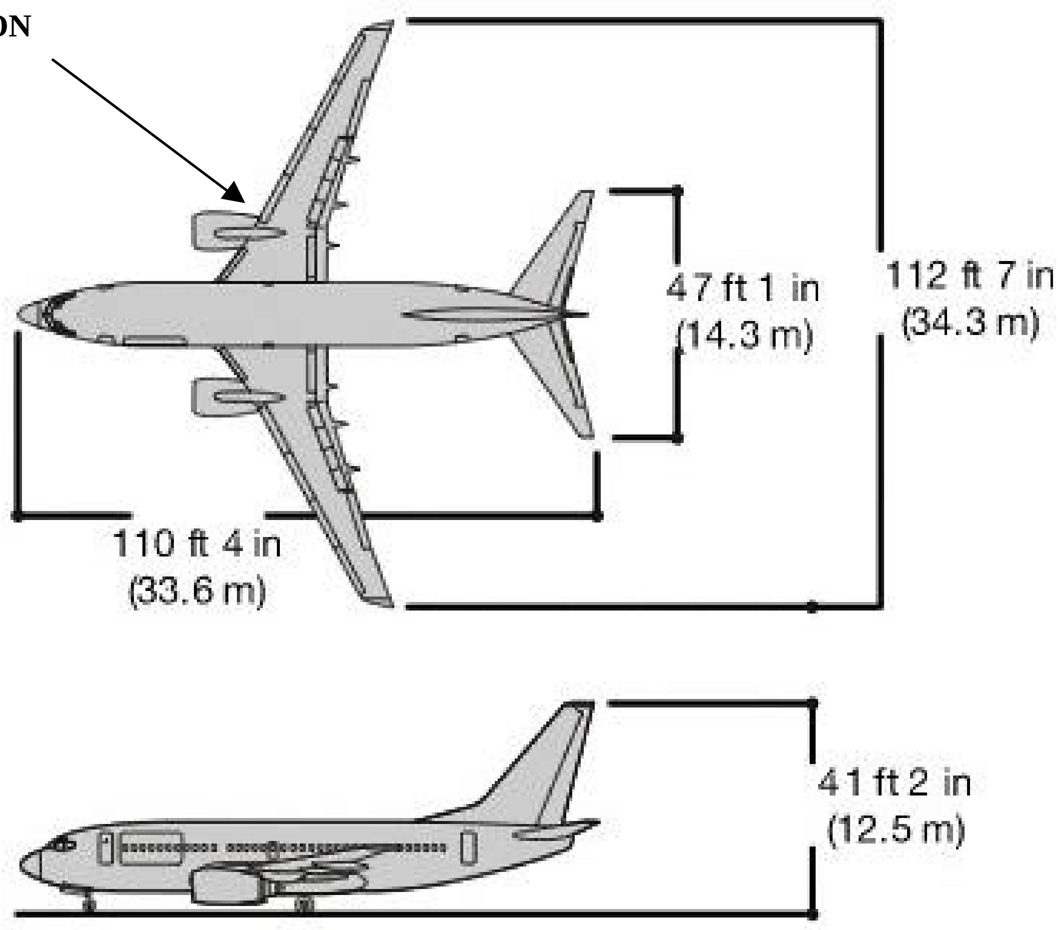
# APPENDIX C

# AIRCRAFT: C-40

## AIRCRAFT DIMENSIONS AND REFUELING PANEL LOCATION

(The C-40 Clipper is the Navy version of the Boeing B737-700C)

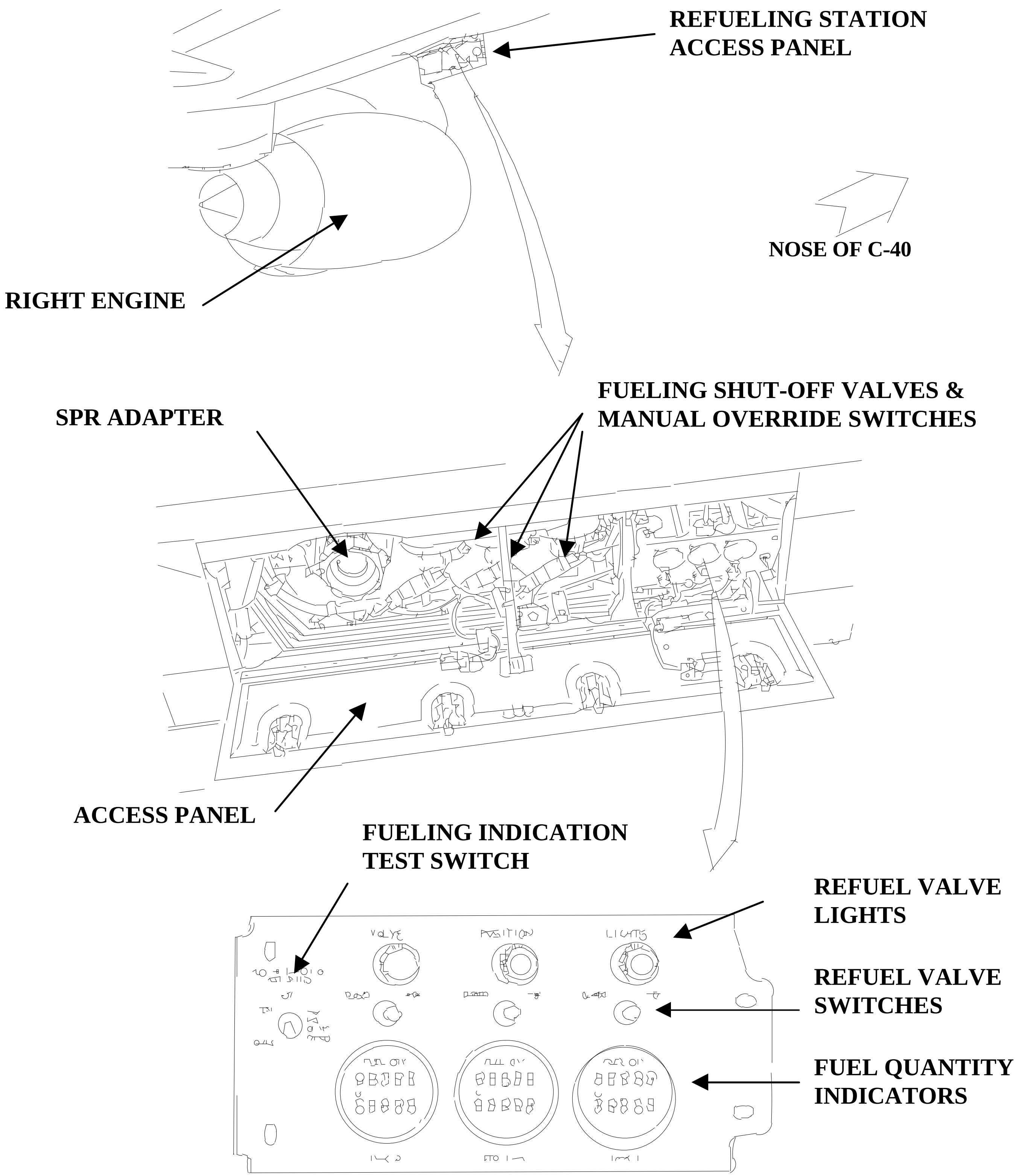
**REFUELING PANEL LOCATION**




The C-40 refueling panel is located just behind the leading edge of the starboard wing outboard of the engine nacelle.

# APPENDIX C

## AIRCRAFT: C-40



# APPENDIX C

# AIRCRAFT: C-40

## C-40 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the C-40 aircraft. They have been extracted from standard commercial refueling procedures for the B737-700 series aircraft. For more detailed information on refueling the C-40, consult the C-40 operations manual. In addition to the following procedures, the applicable basic refueling procedures contained in Chapter 12 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

1. Connect the bonding cable between the refueling equipment and the aircraft.

2. Open the aircraft REFUELING STATION ACCESS PANEL.

3. Connect pressure refueling nozzle to the spr adapter.

4. Hold the FUELING INDICATION TEST SWITCH to ensure indicators operate correctly.

    a. The fueling indicators will blank for 2 seconds
    b. The led segments will then go on for 2 seconds
    c. The above sequence will continue while the TEST SWITCH is held for 20 seconds
    d. Release the TEST SWITCH
    e. If an internal error is found, the indicator will show fail

5. Push and release the FUELING VALVE LIGHTS to test the bulbs. Make sure each FUELING VALVE LIGHT comes on and then goes off.

6. Set REFUEL VALVE SWITCHES to OPEN for tanks to be filled (if full fuel load is required, set all REFUEL VALVE SWITCHES to OPEN).

7. Activate deadman to begin refueling aircraft.

8. Monitor FUEL QUANTITY INDICATORS to ensure that they do not start to FLASH.

**CAUTION**

If INDICATORS flash, STOP fueling as tank can be overfilled.

**NOTE**

Manual returning of a fueling valve to the OFF position during fueling will STOP the fuel flow to THAT TANK.

# APPENDIX C

# AIRCRAFT: C-40

9. When the required amount of fuel has been loaded onto the aircraft, set each FUELING VALVE SWITCH to the CLOSED position.

**NOTE**

Fueling valves will close automatically as each tank reaches FULL.

10. Release the DEADMAN, disconnect pressure refueling nozzle from the SPR adapter, and re-install the SPR adapter cap.

11. Verify that all switches are in the closed position.

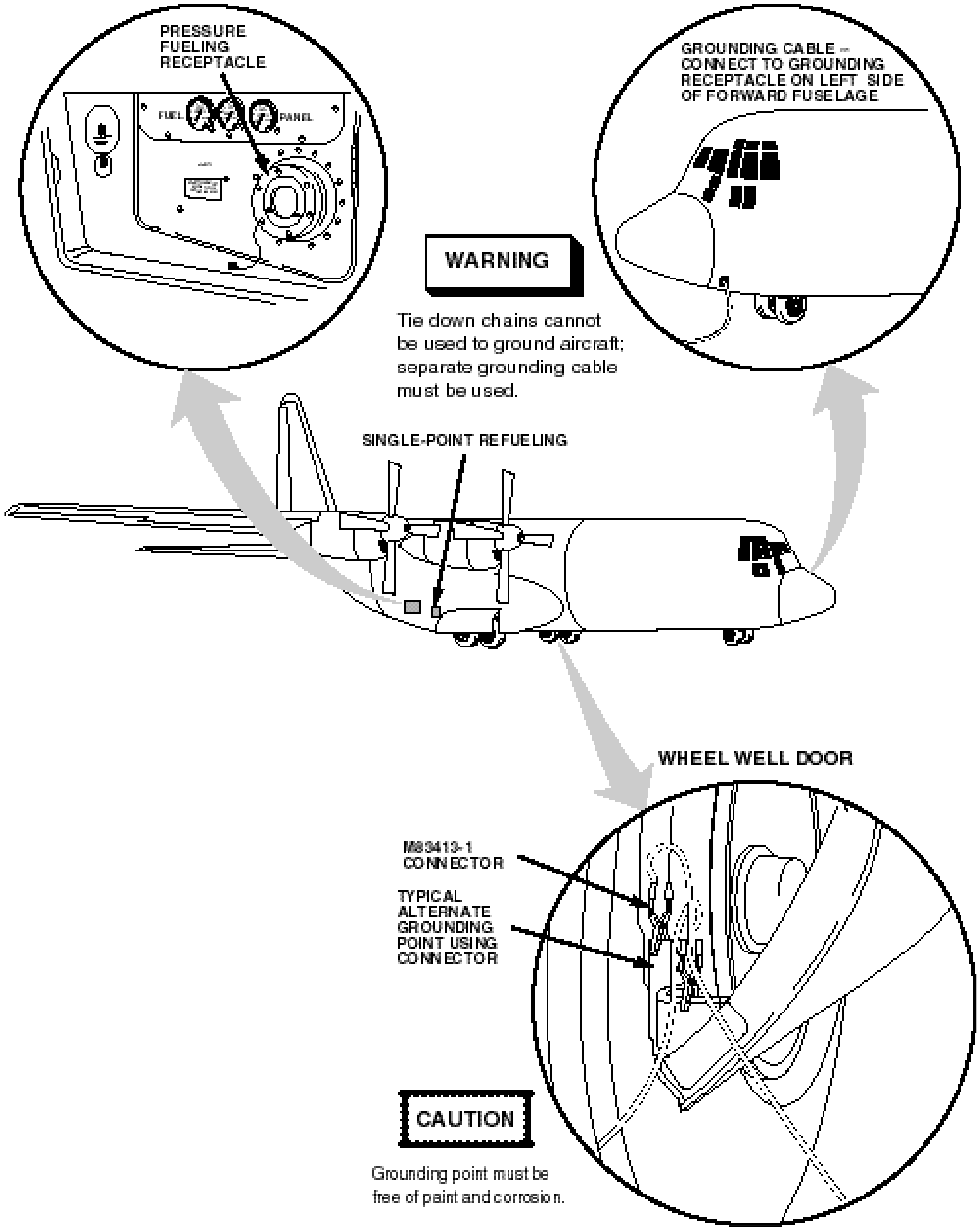
12. Close and securely latch the REFUELING STATION ACCESS PANEL.

13. Disconnect the bonding cable from the aircraft.

# APPENDIX C

## AIRCRAFT: C/KC-130 Series (except –J model)

### AIRCRAFT CONFIGURATION



# APPENDIX C

## AIRCRAFT: C/KC-130 Series (except –J model)

### TABLE OF FUEL CAPACITIES

| Tank | Gallons/Useable |
|---|---|
| Tank No. 1 | 1350/1340 |
| Tank No. 2 | 1240/1230 |
| Left Auxiliary | 910/910 |
| Right Auxiliary | 910/910 |
| Tank No. 3 | 1240/1230 |
| Tank No. 4 | 1350/1340 |
| Left External | 1400/1360 |
| Right External | 1400/1360 |
| Total | 9800/9680 |

### AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Wing Span | 135 ft 7 in | Maximum Gross Weight — 175,000 lbs |
| Length | 101 ft 3 in | Maximum Footprint — 123 psi |
| Height | 38 ft 6 in | |

### C-130 REFUELING PROCEDURES

The following procedures cover only the refueling procedures that are unique to the C-130 aircraft, primarily the operation of the “pre-check” system.

1. Prepare aircraft and refueling system in accordance with the applicable procedure in Chapter 6, 12, or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109.
2. Place the master switch in the REFUEL & GRD TRANS position; place the tank selector switches for the tanks to be refueled in the OPEN position, and place the offload valve switch in the OPEN position.

# APPENDIX C

## AIRCRAFT: C/KC-130 Series (except –J model)

**WARNING**

Maintain balance weight of fuel within 1,000 pounds between each pair of symmetrical tanks and 1,500 pounds between wings, except for auxiliary tanks. It is permissible for one auxiliary tank to be empty when the opposite tank is full.

3. Start the fuel truck pump or fuel pit pump, and establish fuel flow.

**Refuel wing tanks as follows**:

1. If the tanks are not to be filled to capacity, control the servicing with the tank selector switches. Turn the switches to the CLOSE position when the desired fuel level is reached.

2. If the tanks are to be filled to their single-point capacity, make a check of the float-operated shutoff valves as follows:

**Note**

Each tank can be checked individually by directing refueling flow to one tank at a time, or all tanks can be checked simultaneously.

a. Place the master switch in the PRE-CHK PRI position, and observe the fuel quantity gauges. Fuel flow should stop within 15 seconds.

b. Place the master switch in the REFUEL & GRD TRANS position, and reestablish fuel flow.

c. Place the master switch in the PRE-CHK SEC position, and observe the fuel quantity gauges and servicing truck flow meter. Fuel flow should stop within 15 seconds.

d. If either step a or c stops fuel flow into the wing tanks, automatic shutoff is functioning and will stop fuel flow when the single-point capacity is reached. If fuel flow into the tanks does not stop during at least one of the checks, both float valves for that tank have failed and will not shut off fuel flow when the single-point capacity is reached. Therefore, refueling should be accomplished through individual filter ports to prevent overfilling the tank with the inoperative float valves.

**Note**

There are no wing filler ports for the auxiliary fuel tanks in the center wing.

3. Return the master switch to the REFUEL & GRD TRANS position.

4. After wing tanks refueling is complete, place all tank selector switches in the CLOSE position.

5. Place the master switch to the OFF position and the offload valve switch to the CLOSE position.

6. Perform after refueling steps.

# APPENDIX C

## AIRCRAFT: C/KC-130 Series (except –J model)

**Refuel fuselage tank as follows**:

**Note**

An additional man is required to position controls at the flight deck since the fuselage tank is refueled using both the SPR panel and the auxiliary fuel control panel.

1. Place the master switch to the REFUEL & GRD TRANS position and the offload valve switch to the OPEN position.
2. Place the fuselage tank crossfeed switch on the auxiliary fuel control panel to the no-flow position.
3. Place the fuselage tank fill valve switch on the auxiliary fuel control panel to the OPEN position.
4. If the fuselage tank is not to be filled to capacity, control the servicing with the fuselage tank fill valve switch. Turn the fuselage tank fill valve switch to the CL position when the desired fuel capacity on the fuel quantity indicator on the auxiliary fuel control panel is reached.
5. If the fuselage tank is to be filled to the single-point capacity, check the float-operated shutoff valve as follows:

   a. Place the fuselage tank fill valve switch on the auxiliary fuel control panel to the PRETEST PRIM position, and observe the servicing truck flowmeter. Fuel flow should stop within 15 seconds.

   b. Place the fuselage tank fill valve switch in the OPEN position and reestablish fuel flow into the fuselage tank.

   c. Place the fuselage tank fill valve switch on the auxiliary fuel control panel to the PRETEST SEC position and observe the servicing truck flowmeter. Fuel flow should stop within 15 seconds.

   d. Place the fuselage tank fill valve switch in the OPEN position and reestablish the fuel flow to the fuselage tank.

   e. If either step a or c stops fuel flow into the fuselage tank, automatic shutoff is functioning and will stop fuel flow when the single-point capacity is reached. If fuel flow into the fuselage tank does not stop during at least one of the checks, both float valves for the fuselage tank have failed and will not shut off fuel flow when the single-point capacity is reached. Therefore, fuselage tank fueling should be stopped at least 1,000 pounds less than full in accordance with step 4.

**CAUTION**

If the fuselage tank is filled to capacity, filling the wing tanks to capacity will exceed the gross weight limit.

# APPENDIX C

## AIRCRAFT: C/KC-130 Series (except –J model)

6. Place the offload valve switch on the SPR panel to the CLOSE position.

7. Place the fuselage tank fill valve switch on the auxiliary fuel control panel to the CL position.

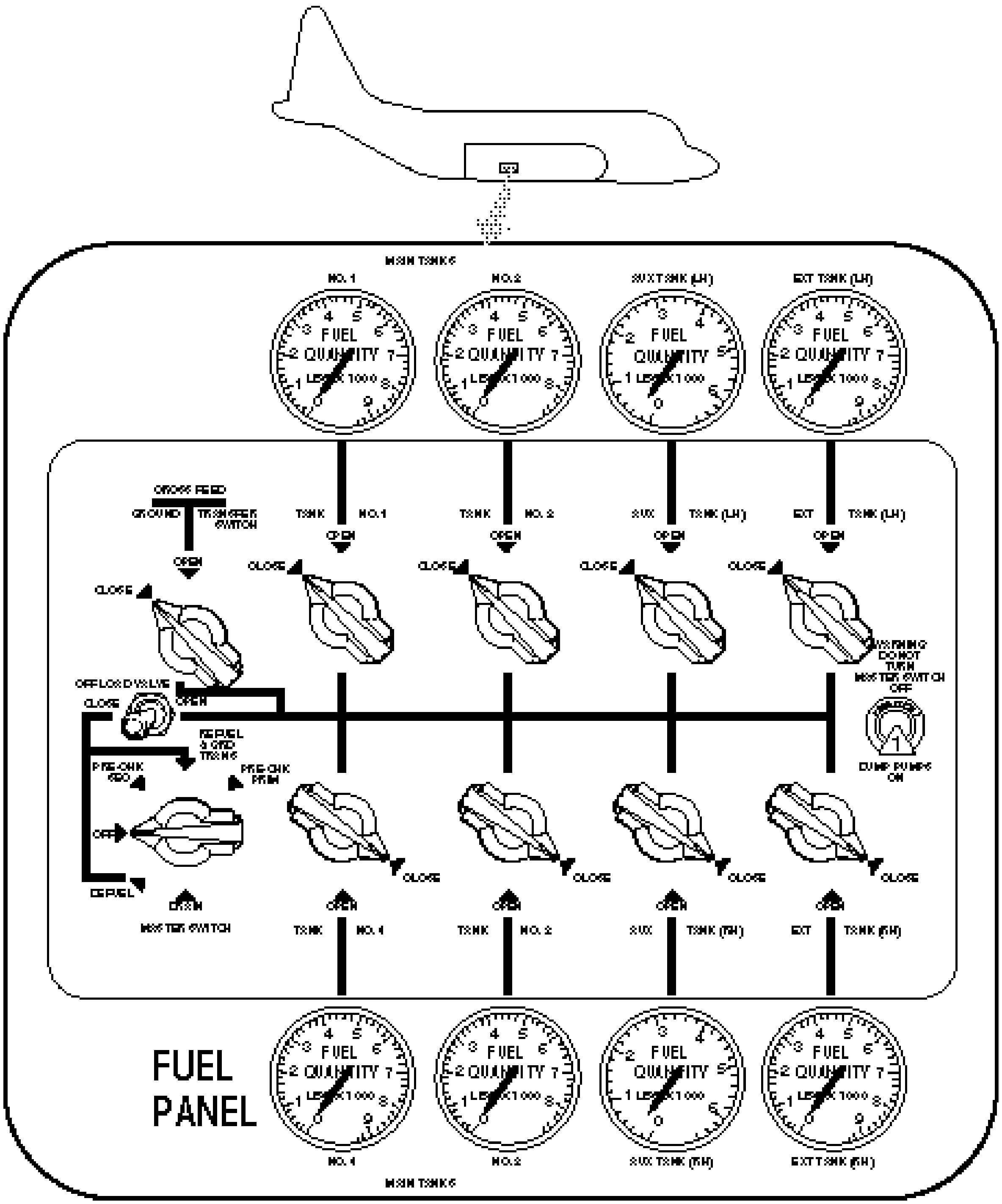
**Note**

Refuel the aircraft through the single-point refueling system by using battery power only when neither external power nor over-the-wing equipment is available. Follow special procedures contained in the applicable NATOPS Manual.

## APPENDIX C

## AIRCRAFT: C/KC-130 Series (except –J model)

### GROUND REFUELING PANEL



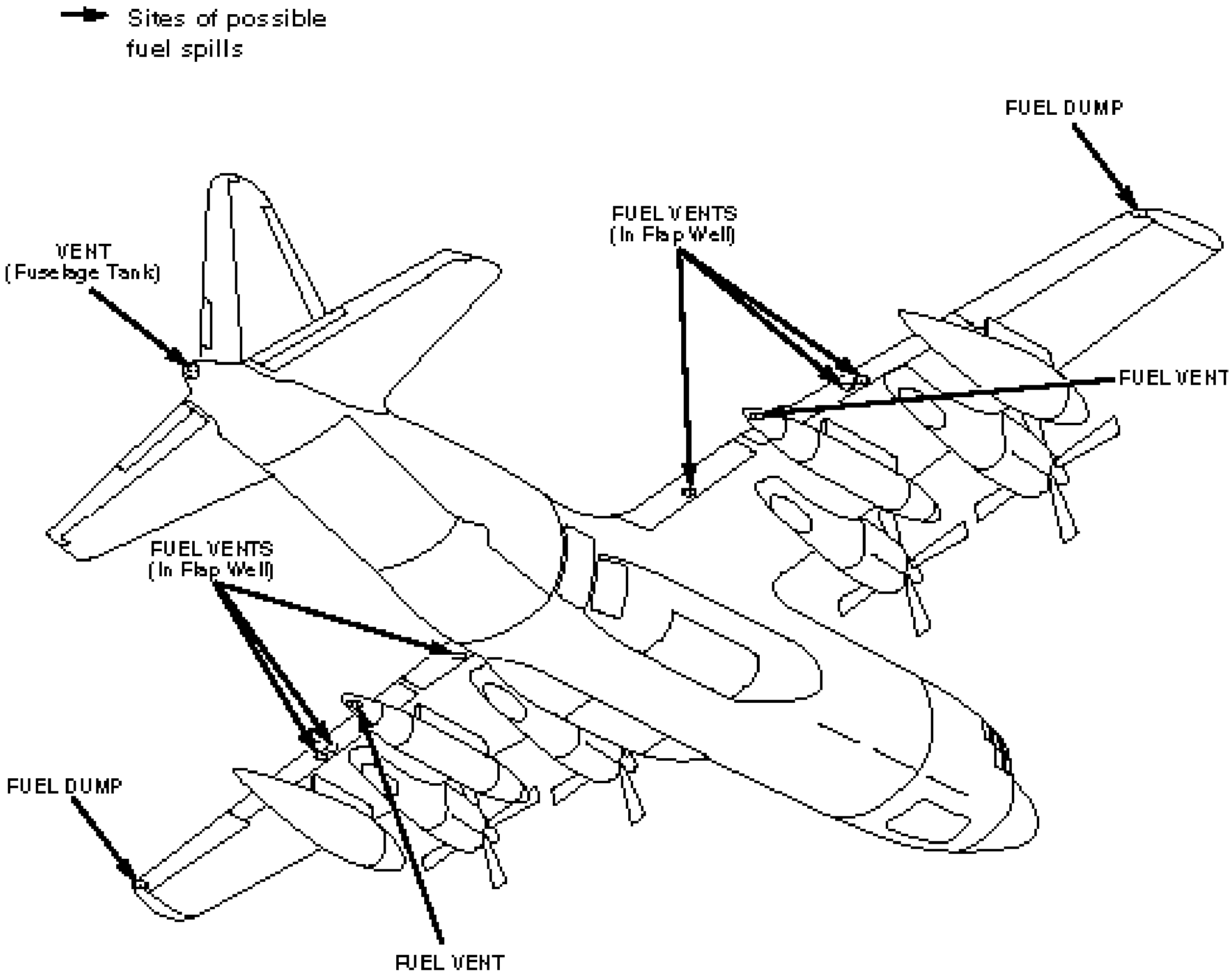

NOTE

⚠1 AIRCRAFT 151888 THROUGH 159469.

# APPENDIX C

# AIRCRAFT: C/KC-130 Series (except –J model)

## VENTS AND DUMPS

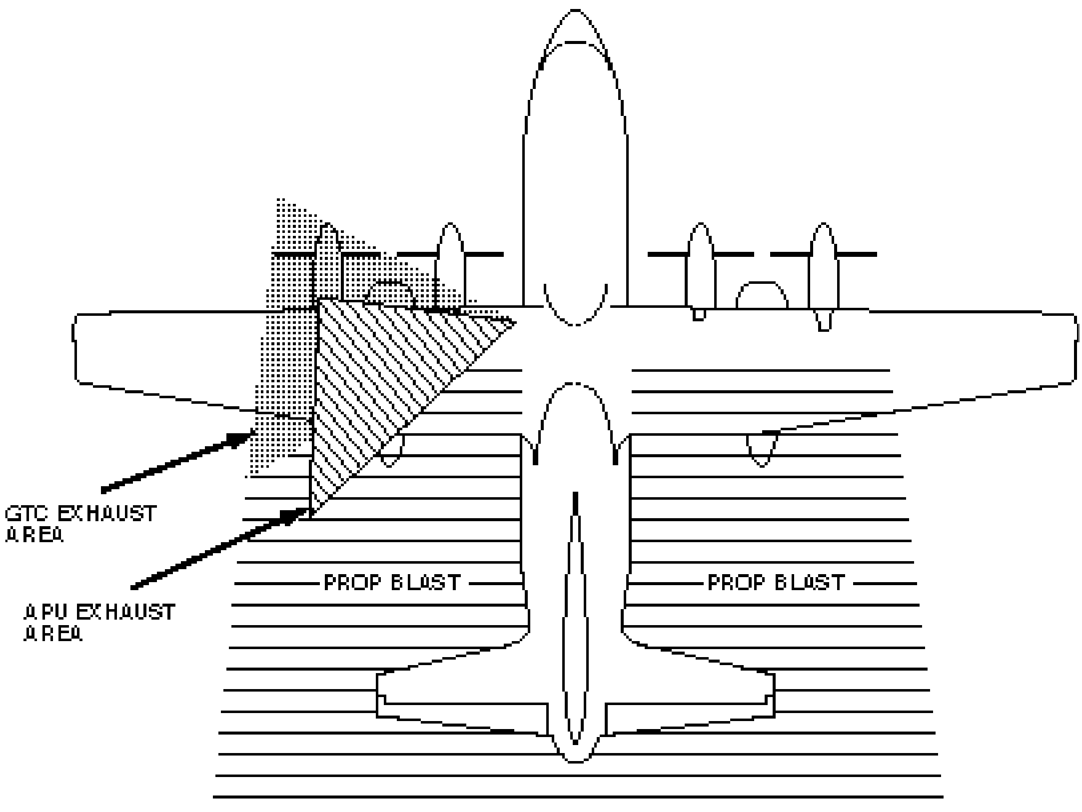


# APPENDIX C

# AIRCRAFT: C/KC-130 Series (except –J model)

## PERSONNEL DANGER ZONES

## (PROP/ENGINE HAZARD AREAS)




MAXIMUM POWER, NO WIND

| | | | | | |
|---|---|---|---|---|---|
| DISTANCE AFT OF PROPS – FEET | 100 | 200 | 300 | 400 | 500 |
| WAKE VELOCITY – KNOTS | 128 | 107 | 92 | 80 | 69 |

# APPENDIX C

# AIRCRAFT: KC-130J

Externally, the KC-130J aircraft looks similar to earlier models of the C/KC-130 family. The noticeable difference is the 6-bladed propellers in place of the older models' 4-bladed propellers.

The KC-130J refueling panel is located in the same area of the aircraft as earlier model C/KC-130 aircraft (on the right wheel well bulge near the right side troop door). The KC-130J refueling panel is not the same as the earlier models' ground refueling panels; major differences are:

1. The KC-130J refueling panel has only one SPR adapter.
2. The KC-130J refueling panel does not have all of the switches and gauges found on the earlier models' ground refueling panels (all controls/indicators are located in the cockpit)

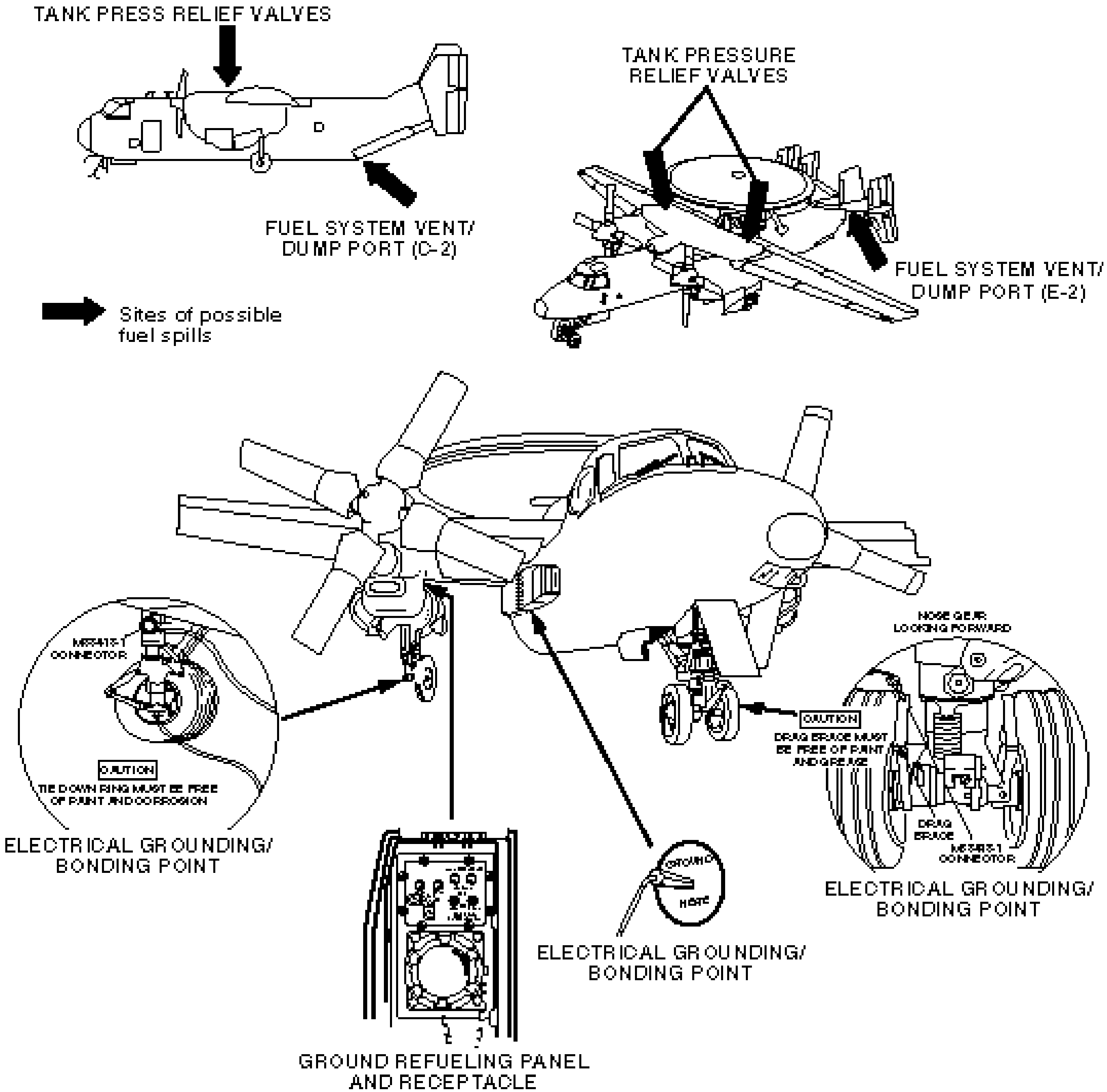
The location of grounding/bonding points and fuel vents/dumps is similar to earlier C/KC-130 models. The personnel danger zone is also similar to that of earlier models.

Once more specific information becomes available, it will be disseminated via a change to this handbook.

## APPENDIX C

## AIRCRAFT: E-2/C-2

## AIRCRAFT CONFIGURATION



# APPENDIX C

## AIRCRAFT: E-2/C-2

### TABLE OF FUEL CAPACITIES

| Tank | | Gallons |
|---|---|---|
| Wings | Left | 912 |
| | Right | 912 |
| | Total Internal | 1,824 |

### AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Wing Span<br>Spread<br>Folded | <br>80 ft 7 in<br>29 ft 4 in | Maximum Gross Weight — 53,000 lbs |
| Length | 57 ft 7 in | Maximum Footprint — 260 psi |
| Height | 18 ft 4 in | |

### E-2/C-2 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the E-2/C-2 aircraft, primarily the operation of the “precheck” system. In addition to these specialized procedures, the applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

**WARNING**

E-2 aircraft are normally hot refueled with both engines operating. DO NOT ASSUME RIGHT ENGINE TURNED OFF until confirmation obtained.

1. Open “PRESS FUEL STA” access door.

2. Remove receptacle cap, attach refueling nozzle, open nozzle to the fully open and locked position and initiate fuel flow. “NOT FULL” lights on pressure fueling station should illuminate.

# APPENDIX C

# AIRCRAFT: E-2/C-2

CAUTION

- Discontinue Hot Refueling operation immediately if “NOT FULL” lights fail to illuminate.

- Ensure that vent at tail of aircraft is clear and that tanks are venting during fueling. If no venting is indicated, cease fueling operation immediately.

3. Hold left “TANK PRECHECK” switch to “PRIM.” After the left “NOT FULL” light goes off (approximately 3 seconds later) hold the right “TANK PRECHECK” switch to “SEC.” After the right “NOT FULL” light goes off fuel flow into the aircraft should stop.
4. Release switches and fuel flow should resume.
5. Repeat the precheck process in step 3 above, this time holding the left “TANK PRE-CHECK” switch to “SEC” and the right “TANK PRECHECK” switch to “PRIM.”

CAUTION

If fuel flow does not stop when “NOT FULL” lights go off in either step 3 or 5 above, discontinue hot refueling operation immediately. System failure should be investigated and resolved before hot refueling can be accomplished.

6. Release switches and refuel aircraft until pilot gives hand signal indicating aircraft is full or he wishes refueling terminated.

WARNING

Aircraft should not be completely filled during hot refueling operations, since failure of a high-level shut-off valve will result in fuel flowing out of the pressure relief valve and onto an engine exhaust pipe.

# APPENDIX C

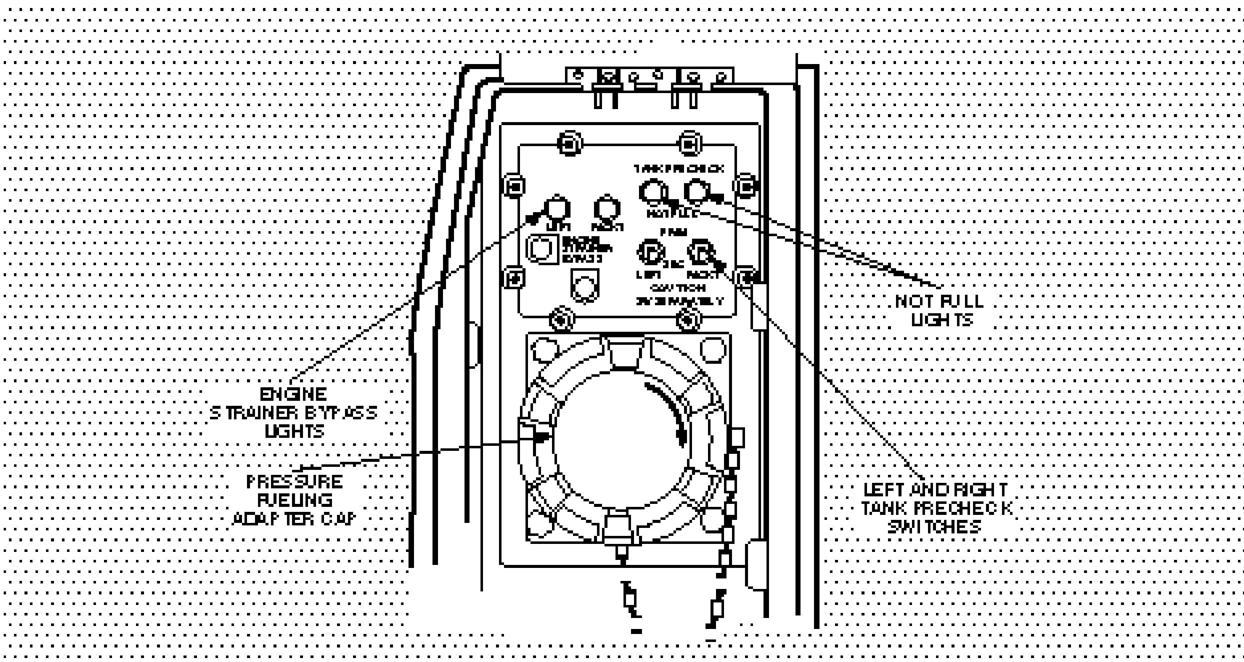
# AIRCRAFT: E-2/C-2

## SPECIAL NOTES — AIRCRAFT FUEL SYSTEM

1. Under normal conditions, all air being displaced by fuel in the tanks exits the aircraft through the common “Fuel System Vent/Dump Port” (in the tail on the E-2 and on the fuselage on the C-2).

2. If any high-level shut-off valve fails to operate correctly, fuel may spill from special pressure relief valves on the tops of the wings.

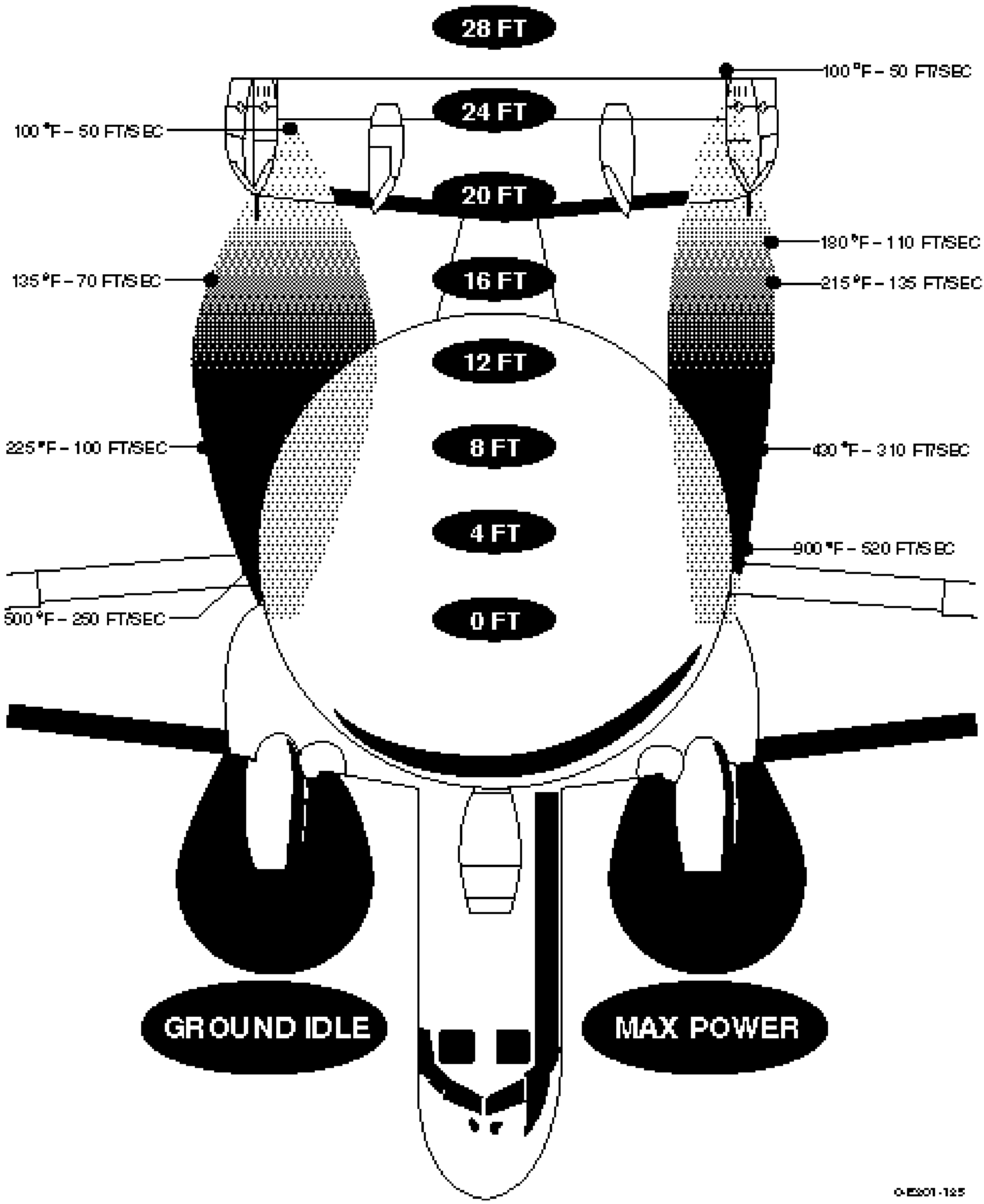
### GROUND REFUELING PANEL



## APPENDIX C

## AIRCRAFT: E-2/C-2

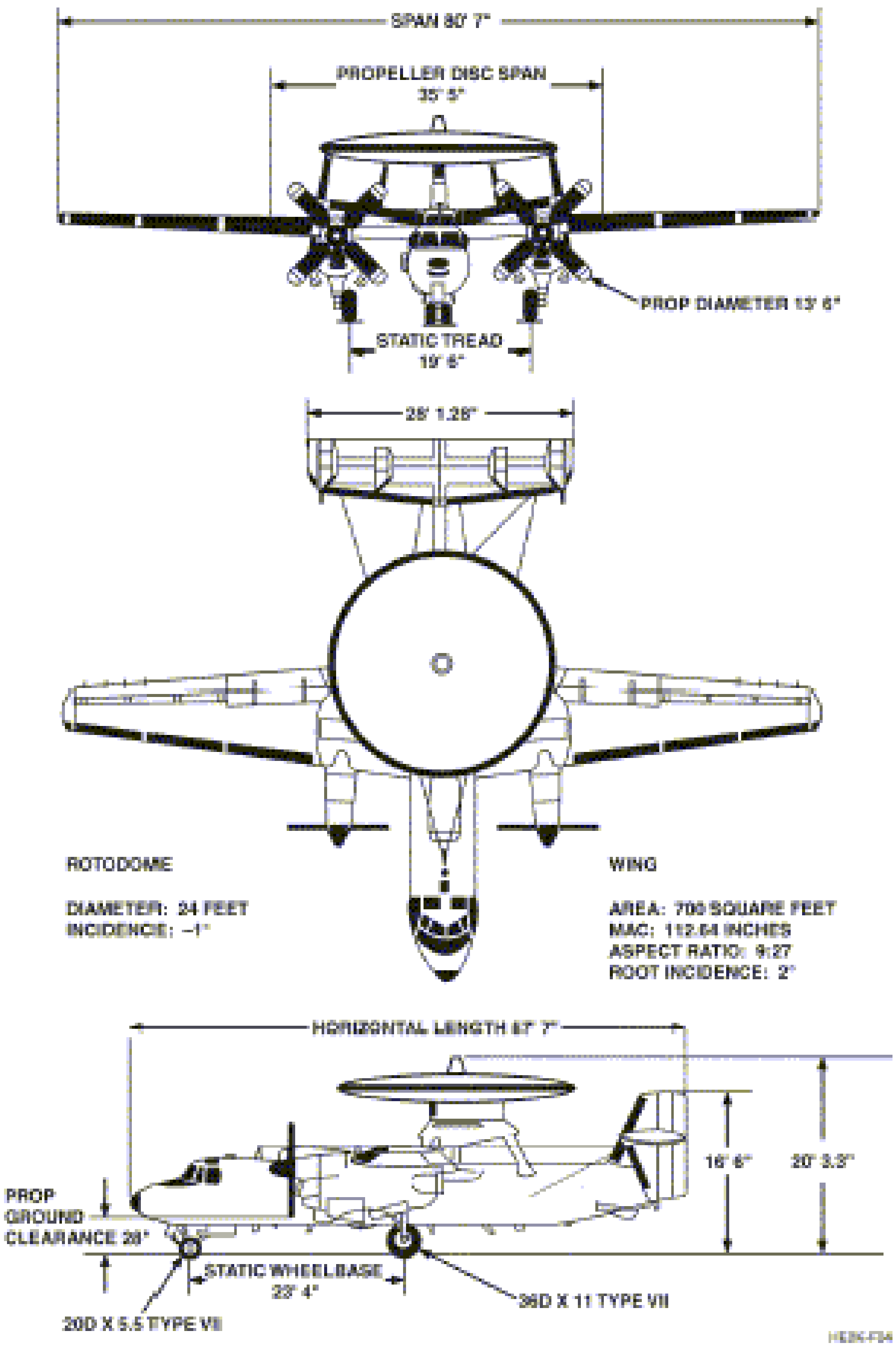
### PERSONNEL DANGER ZONES



# APPENDIX C

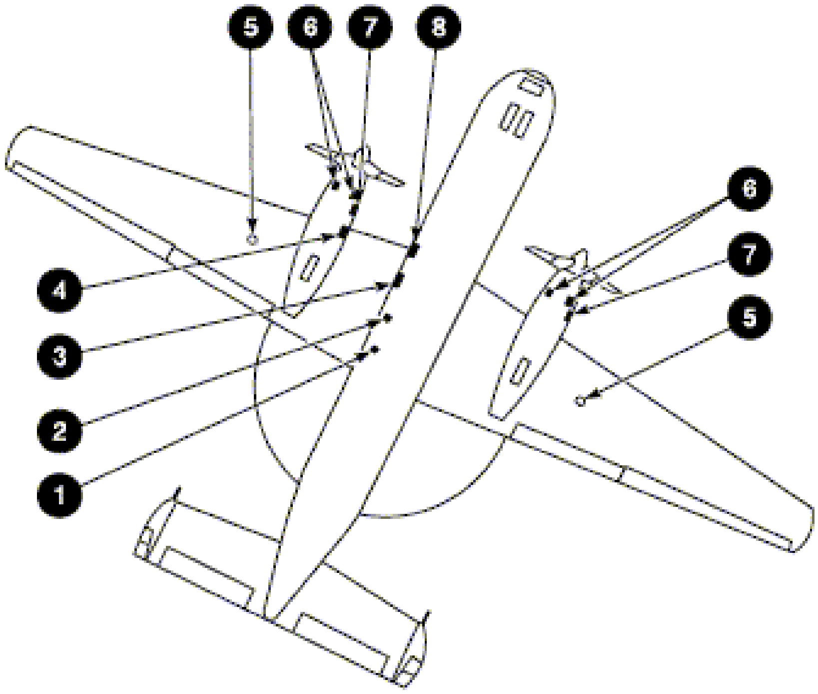
# AIRCRAFT: E-2C 2000

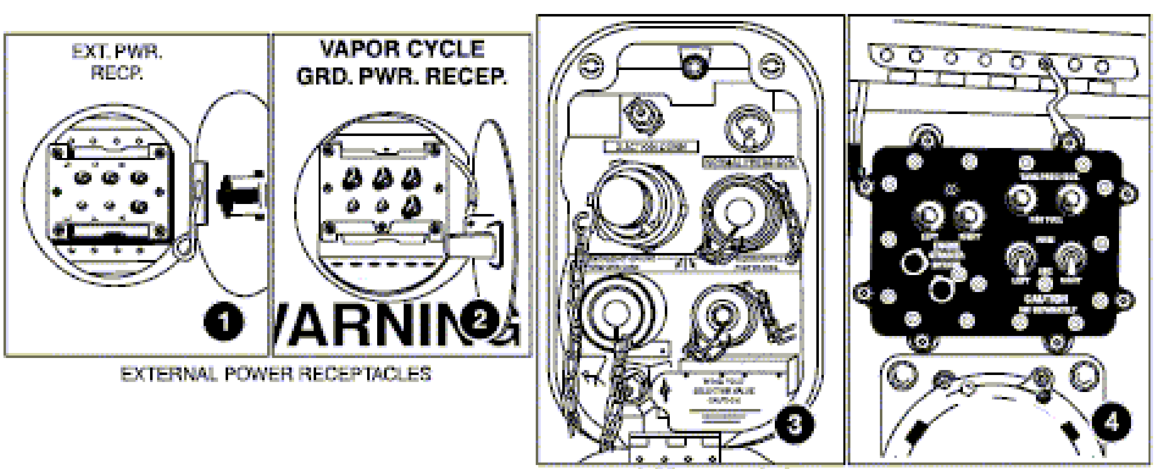
## AIRCRAFT CONFIGURATION



# APPENDIX C

## AIRCRAFT: E-2C 2000
**SERVICING LOCATIONS (1 of 2)**




EXTERNAL POWER RECEPTACLES

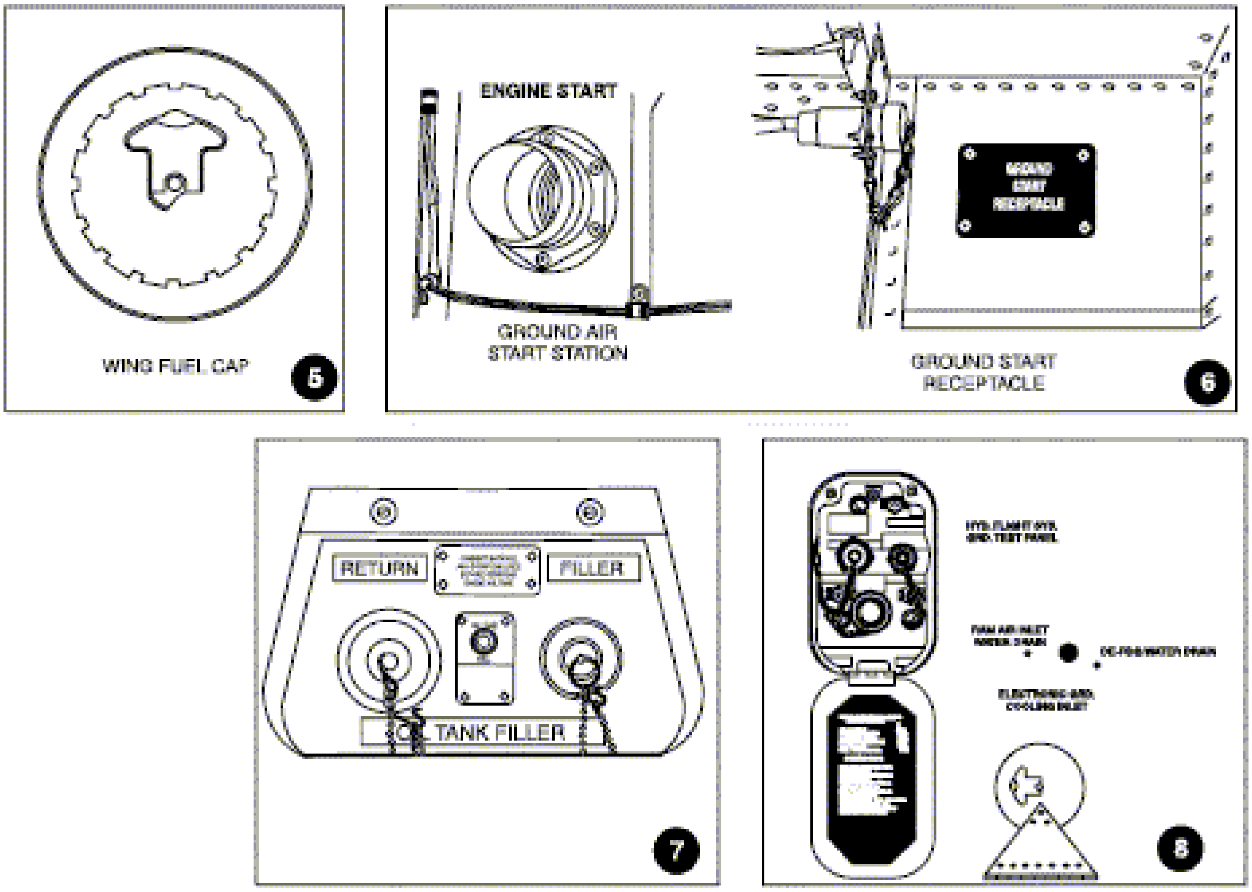
HYDRAULIC COMBINED SYSTEM GROUND TEST PANEL

PRESSURE FUELING STATION

# APPENDIX C

# AIRCRAFT: E-2C 2000

## **SERVICING LOCATIONS** (2 of 2)




PRESSURE FILLING STATION

HYDRAULIC FLIGHT SYSTEM
GRD TEST PANEL

# APPENDIX C

# AIRCRAFT: E-2C 2000

**Pressure Fueling System.** Fuel is admitted to both tanks simultaneously by a pressure fueling system that provides high-speed fueling and defueling. The single-point fueling station is on the inboard side of the right nacelle. This station has the fueling adapter and the tank precheck panel on which the switches and lights necessary for checking the system are mounted. Though the system is hydromechanical, external electrical power should be available to check that all components are functioning properly.

Fueling is initiated by pressure (from the fueling hydrant or truck) acting upon the fueling valves in the tanks forcing the valves open. When the valves are open, two green lights (NOT FULL) on the TANK PRECHECK panel go on to indicate that fuel is entering each tank. Fueling is automatically terminated in each tank by float-operated, high-level control valves. Each of these valves is, in effect, two valves because it consists of two independently operating floats: one primary float and one secondary float. In addition to the dual protection of the two high-level control valves, each tank has a relief valve that prevents the tanks from rupturing if the control valves malfunction. When one of these floats is actuated by the rising fuel level, it causes the fueling shutoff valve to close and the light on the tank precheck panel goes off to indicate that the tank is full and that fueling has stopped. The relief valves start to open when tank pressure reaches 11.5 psig. They are fully open at 12.5 psig and permit fuel to flow overboard.

**3.2.1.1 Precheck Switches.** Two tank precheck toggle switches are on the TANK PRECHECK panel at the pressure fueling station. They are spring loaded to the off (center) position and have positions PRIM and SEC. Setting the switch to SEC actuates a solenoid in the high-level control valve. This permits a calibrated spring to lift the secondary float, thereby simulating a full tank condition. The fueling shutoff valve then closes and the NOT FULL warning light goes off to indicate that the tank has been shut down. Setting the switch to PRIM repeats the cycle for the primary float.

**CAUTION**

Sequential actuation of the left and right tank high level control valve solenoid is necessary to ensure that fueling operation automatically terminates.

**3.2.1.2 Fuel Tank Not Full Warning Lights.** The NOT FULL warning lights are green press-to-test lights on the tank precheck panel. They go on to indicate that the fueling shutoff valve is open to permit fuel to enter the tank.

# APPENDIX C

# AIRCRAFT: E-2C 2000

**3.2.2 Preparation for Fueling.** Only authorized and qualified personnel should be permitted to operate fueling equipment. During the fueling process, loose pyrotechnics, smoking, striking matches, working on aircraft, LOX servicing, or producing flame within 50 feet of the aircraft or truck is strictly prohibited.

**3.2.2.1 Position of Aircraft and Truck.** The aircraft should not be located in the vicinity of possible sources of ignition such as blasting, drilling, or welding operations. A minimum of 50 feet should be maintained from other aircraft and 1,000 feet from any operating radar set.

**3.2.2.2 Grounding.** Prior to fueling, grounding devices on the aircraft and drag chains on the truck will be inspected by fueling personnel for proper ground.

**3.2.2.3 Electrical Hazards.** Turn off all radio and electrical switches in aircraft prior to fueling. Check that no electrical apparatus supplies by outside power (electrical cords, droplights, floodlights, etc.) is in or near the aircraft. For night fueling, safety flashlights should be used.

**3.2.2.4 Attaching Ground Wire.** Before removing the pressure fueling adapter cap, the hose nozzle grounding attachment should be connected to the aircraft ground connection.

**3.2.2.5 Fire Extinguisher and Attendant.** During fueling, a secondary operator or assistant plane captain should man a properly serviced $CO_2$ hand extinguisher, with a properly serviced second extinguisher readily available.

**3.2.3 Fueling Procedure**

1. Install ground locks.

2. Close FUELING and LEFT TR BUS FDR circuit breakers on main power distribution box circuit breaker panel.

3. Connect external electrical power to aircraft.

4. Turn the EXT PWR NO. 1 AC PWR switch to RESET then ON.

5. Open PRESS FUEL STA access door (right nacelle, inboard side only) and check LEFT and RIGHT ENGINE STRAINER BYPASS lights. If either light is on, respective engine low-pressure fuel filters are clogged and corrective maintenance should be performed. Notify supervisor.

6. Before removing pressure-fueling adapter cap, the hose nozzle grounding attachment should be connected to the aircraft ground connection.

## APPENDIX C

## AIRCRAFT: E-2C 2000

7. Remove cap from pressure-fueling adapter, insert pressure-fueling nozzle, and lock nozzle in adapter.

8. Commence fueling. NOT FULL lights on pressure-fueling station go on, indicating that fuel is entering tanks. Ensure that vent at tail of aircraft is clear and that tanks are venting during fueling. If no venting is indicated, cease fueling operation immediately.

**CAUTION**

Maximum fueling pressure should be limited to 60 psi and a flow rate of 250 GPM.

**Note**

When only partial fuel load is required in each tank, close FUEL QTY LEFT TANK and RIGHT TANK circuit breakers, and station observer in cockpit to monitor fuel quantity indicators. If aircraft is to be fully fueled, cockpit monitor is not required.

9. Hold left TANK PRECHECK switch to PRIM. After the left NOT FULL light goes off (approximately 3 seconds later) hold the right TANK PRECHECK switch to SEC. After the right NOT FULL light goes off, fueling should terminate; release switches and continue fueling. Before aircraft fueling is complete, repeat the above procedure, this time holding the left TANK PRECHECK switch to SEC and the right TANK PRECHECK to PRIM. If fuel flow does not stop when NOT FULL lights go off, turn off fueling source immediately and disconnect pressure fueling nozzle. Notify supervisor.

10. When fuel tanks are full, NOT FULL lights go off and fueling stops automatically.

11. When partial fuel load is required, cockpit monitor should signal to stop fueling when 100 pounds of fuel less than fuel load required for respective tank is indicated on fuel quantity indicator. When signal to stop fueling is given by monitor, fuel flow to each tank is terminated by holding respective TANK PRECHECK switch to SEC.

12. Turn off fueling source and remove pressure fueling nozzle from pressure-fueling adapter. Install cap.

13. Remove hose nozzle grounding cable from aircraft grounding connection.

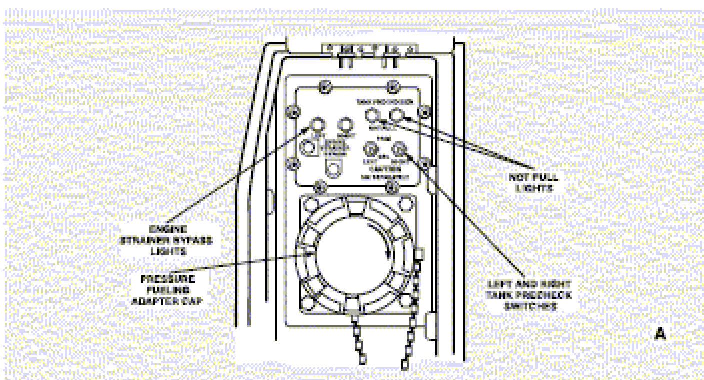
14. Close and secure PRESS FUEL STA access door.

# APPENDIX C

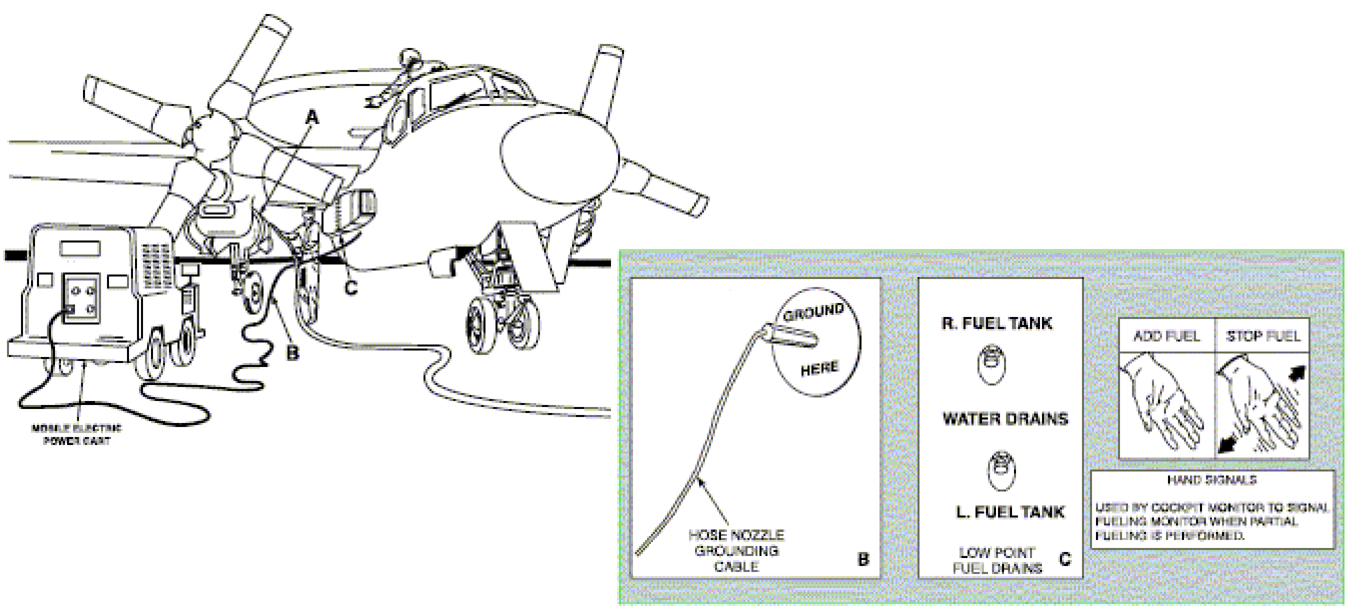
# AIRCRAFT: E-2C 2000

**3.2.3.1 Fueling without Electrical Power.** If electrical power is not available, the aircraft may still be pressure refueled. The tanks may be completely filled, but without electrical power, the operator cannot check the left and right tank not full lights. Without a proper check, the operator will not be certain that fueling will automatically terminate when the tank is full. During refueling without electrical power tank prechecks cannot be performed. Consequently there is no assurance that pressure-fueling will automatically terminate. Personnel and support equipment should be kept clear of the areas aft of the overwing and tail fuel vents.

**3.2.3.2 Emergency Fueling.** Normally, the aircraft is fueled through the pressure-fueling panel on the inboard side of the right engine nacelle. However, if a pressure-fueling nozzle or truck is not available, or if it is otherwise impossible to fuel the aircraft in the normal manner, the tanks can be gravity-filled through tank caps on top of each wing. A ground wire attachment is located at each wing leading edge for proper grounding.



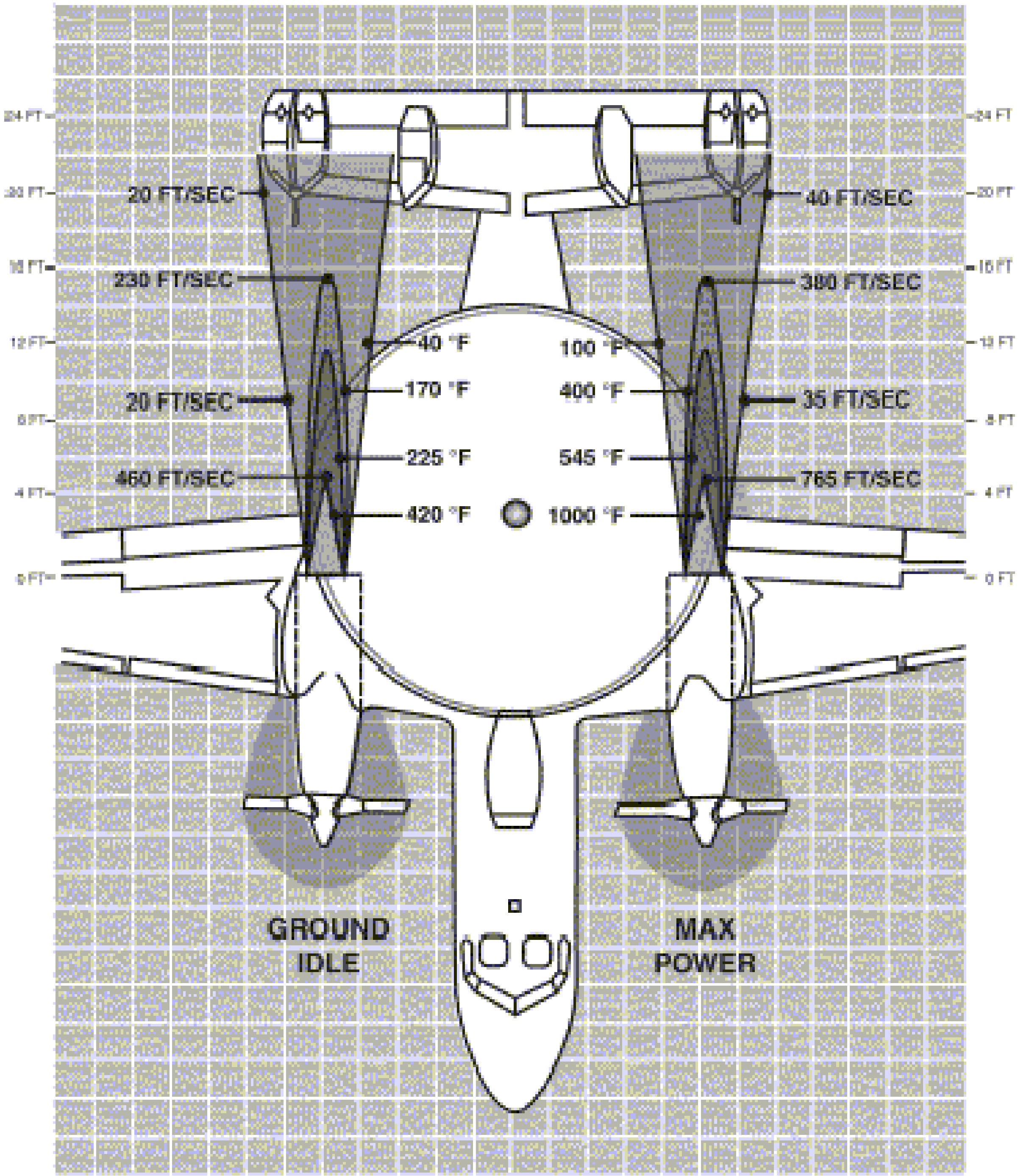

**FUEL SERVICING**



# APPENDIX C

## AIRCRAFT: E-2C 2000

### PERSONNEL DANGER AREAS (1 of 2)

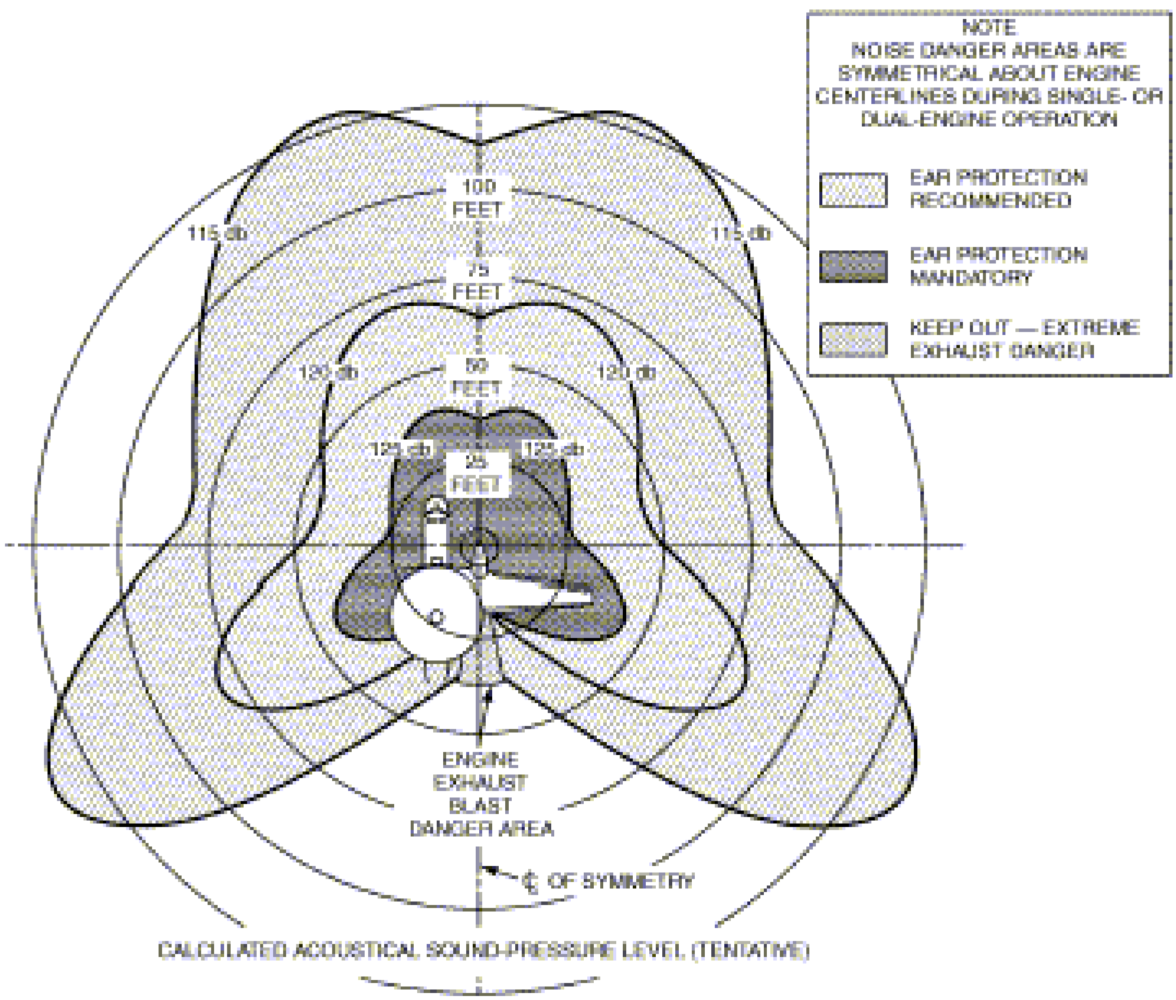


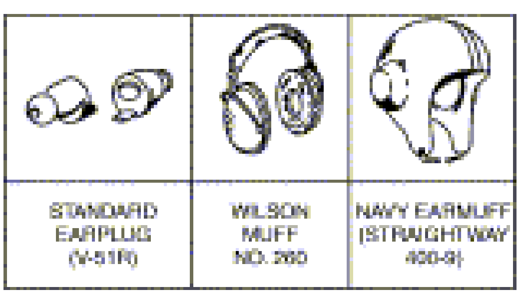
# APPENDIX C

# AIRCRAFT: E-2C 2000

## PERSONNEL DANGER AREAS (2 of 2)

**ENGINE OPERATION** – MAX POWER (SUBTRACT 10db FOR GROUND IDLE VALUES)




DAMAGE RISK CRITERIA

| EAR PROTECTION NECESSARY | EXPOSURE TIME DURATION PER DAY | | | | |
|---|---|---|---|---|---|
| | 5 MINUTES | 15 MINUTES | 30 MINUTES | 1 HOUR | 2 HOURS |
| NO PROTECTION | 99 db | 95 db | 92 db | 89 db | 86 db |
| EARPLUGS | 129 db | 124 db | 121 db | 118 db | 115 db |
| EARPLUGS AND EARMUFFS | 139 db | 134 db | 131 db | 128 db | 125 db |

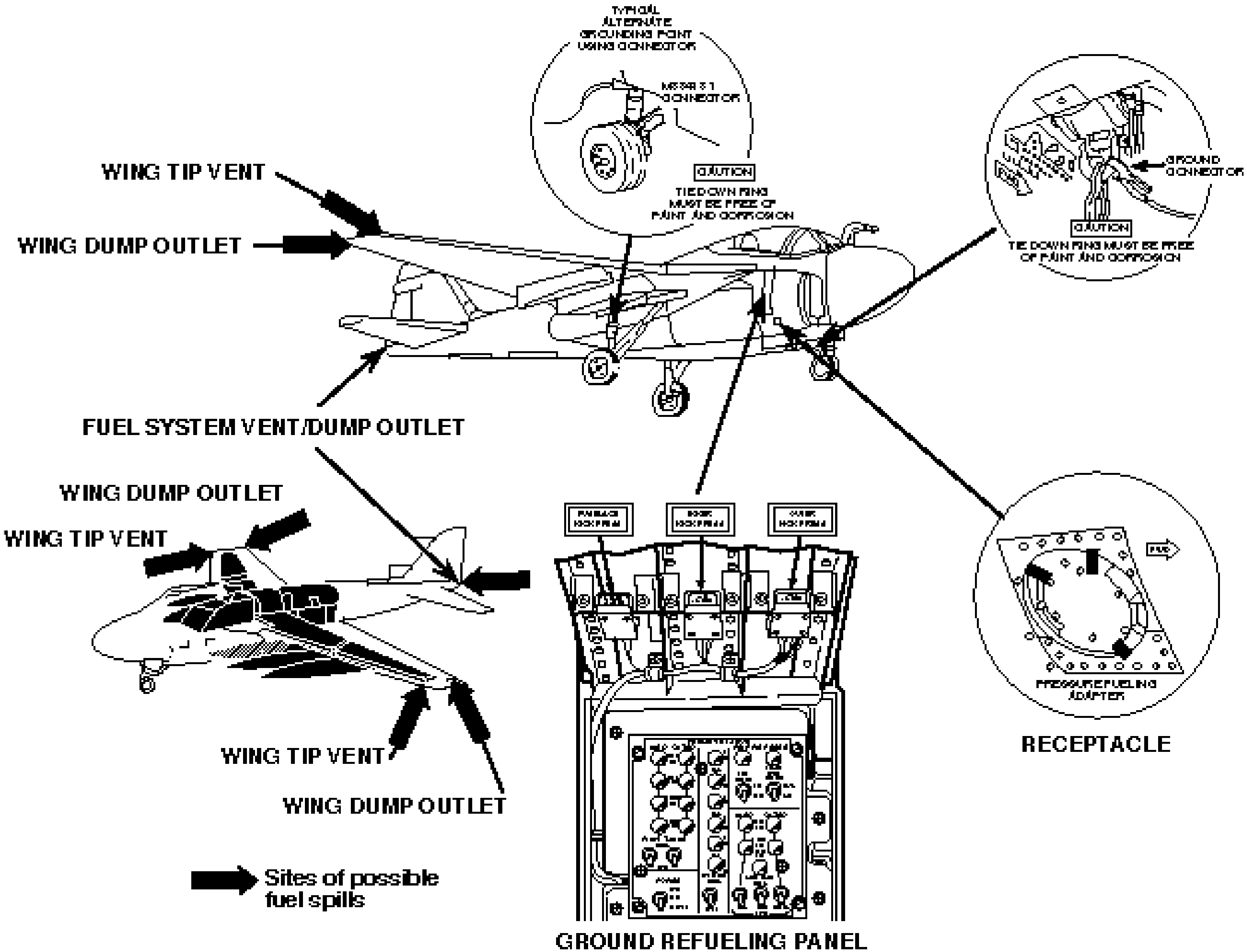
REF. WADC TN 55-355 TO DAMAGE RISK CRITERIA

# APPENDIX C

## AIRCRAFT: E-6

Information on personnel danger areas, location of refueling panel, location of grounding/bonding points, and refueling procedures for this aircraft should be referred to the flight crew.

## APPENDIX C
## AIRCRAFT: EA-6
## AIRCRAFT CONFIGURATION



# APPENDIX C

# AIRCRAFT: EA-6

## TABLE OF FUEL CAPACITIES

| Tank | | Gallons |
|---|---|---|
| Internal | Fuselage | 1,344 |
| | Wing | 1,028 |
| | Total Internal | 2,372 |
| External | Drop Tank (Each)* | 300 |
| | | 400 |
| | Air Refueling Store | 300 |

*Two sizes of tanks are available

## AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Wing Span<br>Spread<br>Folded | <br>53 ft<br>25 ft 4 in | Maximum Gross Weight — 74,350 lbs |
| Length | 54 ft 9 in | Maximum Footprint — 230 psi |
| Height | 16 ft 2 in | |

## EA-6 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the EA-6 aircraft, primarily the operation of the “precheck” system. In addition to these specialized procedures, the applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

**WARNING**

EA-6 aircraft are normally hot refueled with both engines operating. DO NOT ASSUME RIGHT ENGINE TURNED OFF until confirmation obtained.

# APPENDIX C

## AIRCRAFT: EA-6

1. Set “POWER” switch on ground refueling panel to “FUEL,” and set “WING TANKS,” “FUS TANKS,” and “DROP TANKS” switches to “FUEL.”

2. On ground refueling panel access door, press “OUTER HIGH PRESS” indicator. All three “High Pressure” indicator lights on the door should illuminate.

3. On ground refueling panel, momentarily press each “WING TANKS,” “FUS TANKS,” and “DROP TANKS” indicator that is not lighted; each indicator will illuminate.

**CAUTION**

If indicators checked in steps 2 and 3 malfunction, do not fuel aircraft.

4. Attach refueling nozzle to aircraft receptacle and place nozzle flow control handle in the open position.

5. Initiate fuel flow and monitor tank “High Pressure” lights on door above ground refueling panel.

**CAUTION**

Immediately stop fuel flow if any of the three “High Pressure” indicators illuminates during the refueling operation. Cause of vent system overpressure should be corrected before fueling is resumed.

6. Exercise precheck system. Set and hold “SOL CHECK” switch to “PRI.” All “WING TANKS PRI,” “FUS TANKS PRI,” and “DROP TANKS PRI” indicator lights will go out and fuel flow into the aircraft will stop prior to aircraft receiving 45 gallons of fuel.

7. When fuel flow stops, check flow rate. If flow rate exceeds 3 gallons per minute, discontinue hot refueling operation.

8. On ground refueling panel, set “DROP TANKS” switches to “HOLD” and release “SOL CHECK” switch.

9. When fuel flow starts, immediately set and hold “SOL CHECK” switch to “SEC.” All “WING TANKS SEC” and FUS TANKS SEC” indicator lights will go out and fuel flow automatically stop prior to aircraft receiving 30 gallons of fuel.

10. When fueling stops, check fuel flow rate. If flow rate exceeds 3 gallons or 20 pounds per minute, shut off fueling unit and disconnect fuel nozzle.

11. On ground refueling panel, set “WING TANKS” switches to “HOLD” and release “SOL CHECK” switch.

12. Fuel fuselage tanks until “FUS TANK” indicators on ground refueling panel go out.

13. On ground refueling panel, set “WING TANKS” switches to “FUEL”; on aircraft with external tanks, set “DROP TANKS” switches to “FUEL.” When “WING TANKS,” “FUS TANK,” and “DROP TANKS” indicators are all out, aircraft is fueled.

14. Set “POWER” switch to “OFF” on ground refueling panel.

**SPECIAL NOTES — AIRCRAFT FUEL SYSTEM**

1. Under normal conditions, all air being displaced by fuel in the tanks, including external tanks, exits the aircraft through the common “Fuel System Vent/Dump Outlet.”

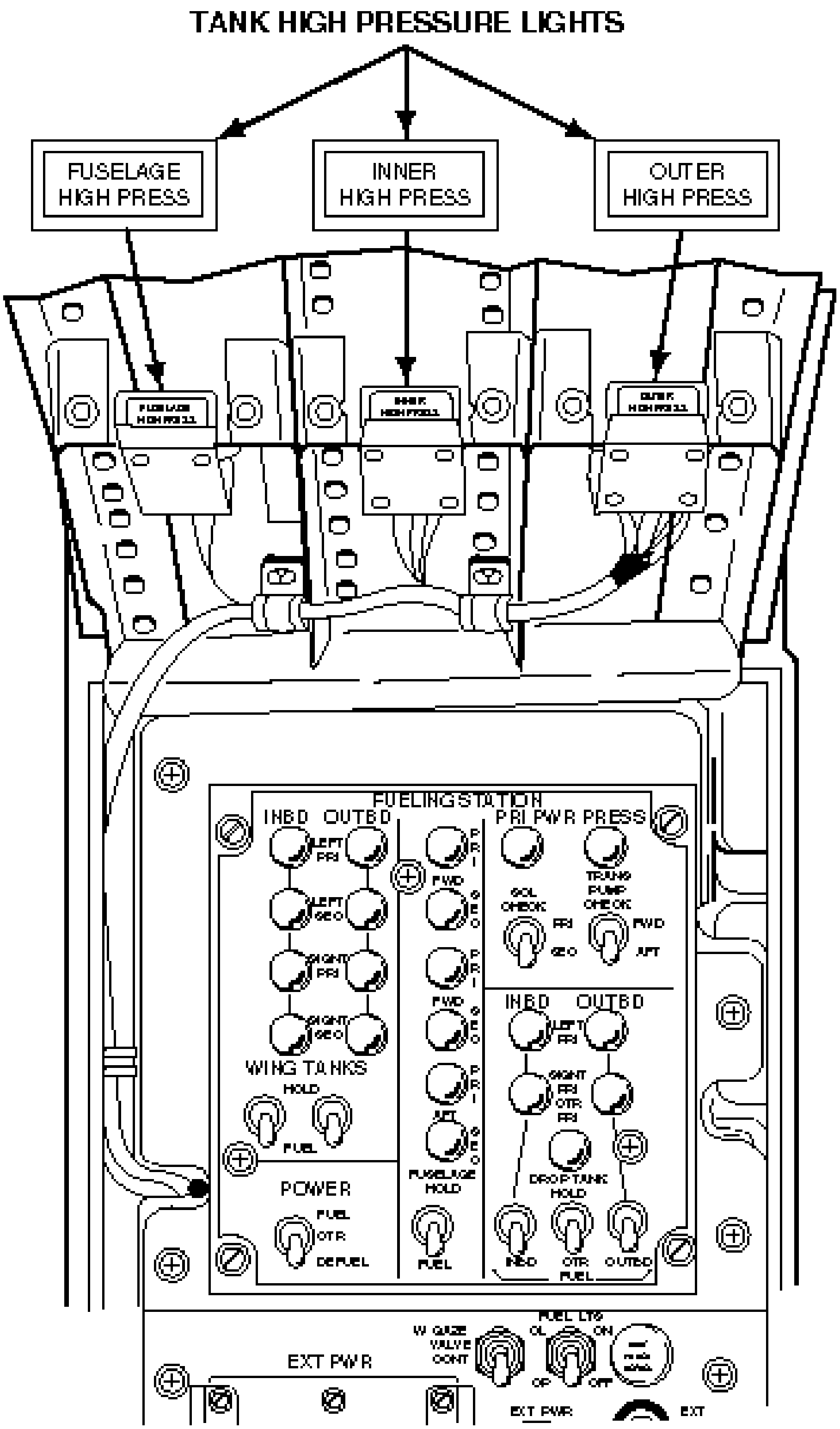
2. If any high level shut-off valves fail to operate correctly, fuel may spill from the “Fuel System Vent/Dump Outlet” or the “Wing Tip Vents.”

3. A malfunction within an external fuel tank may cause fuel to spill from the bottom center of tank (pressure relief vent).

# APPENDIX C

## AIRCRAFT: EA-6

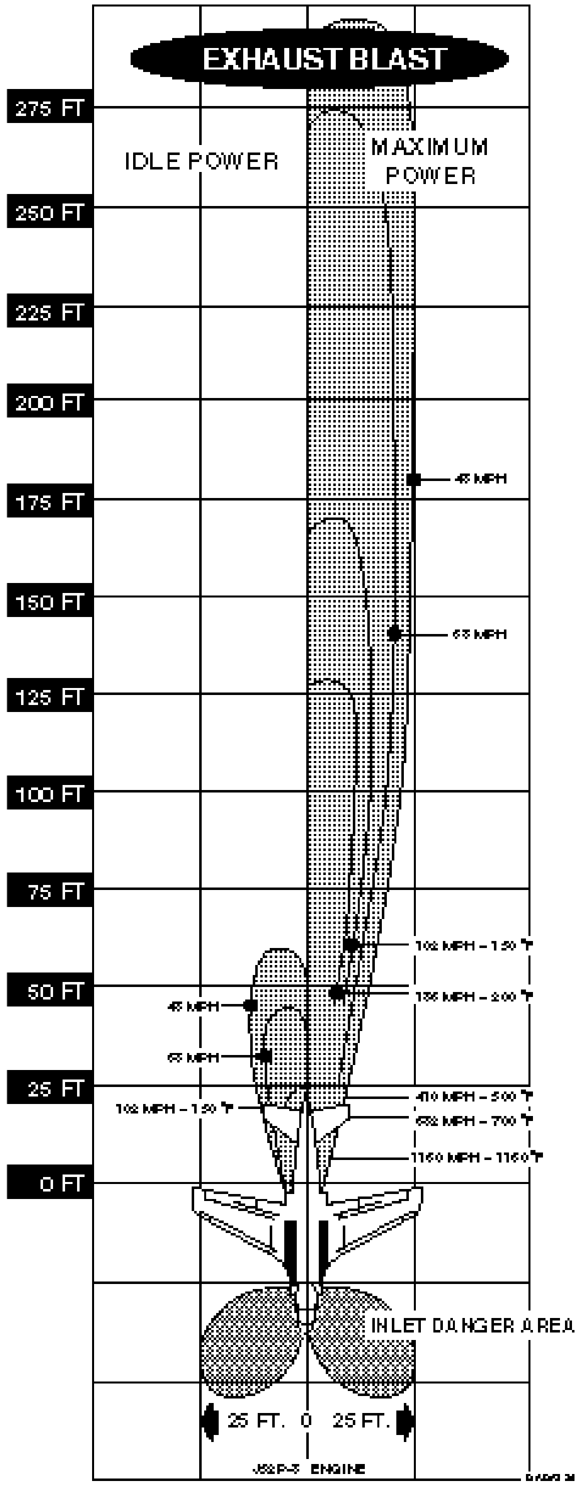
### GROUND REFUELING PANEL



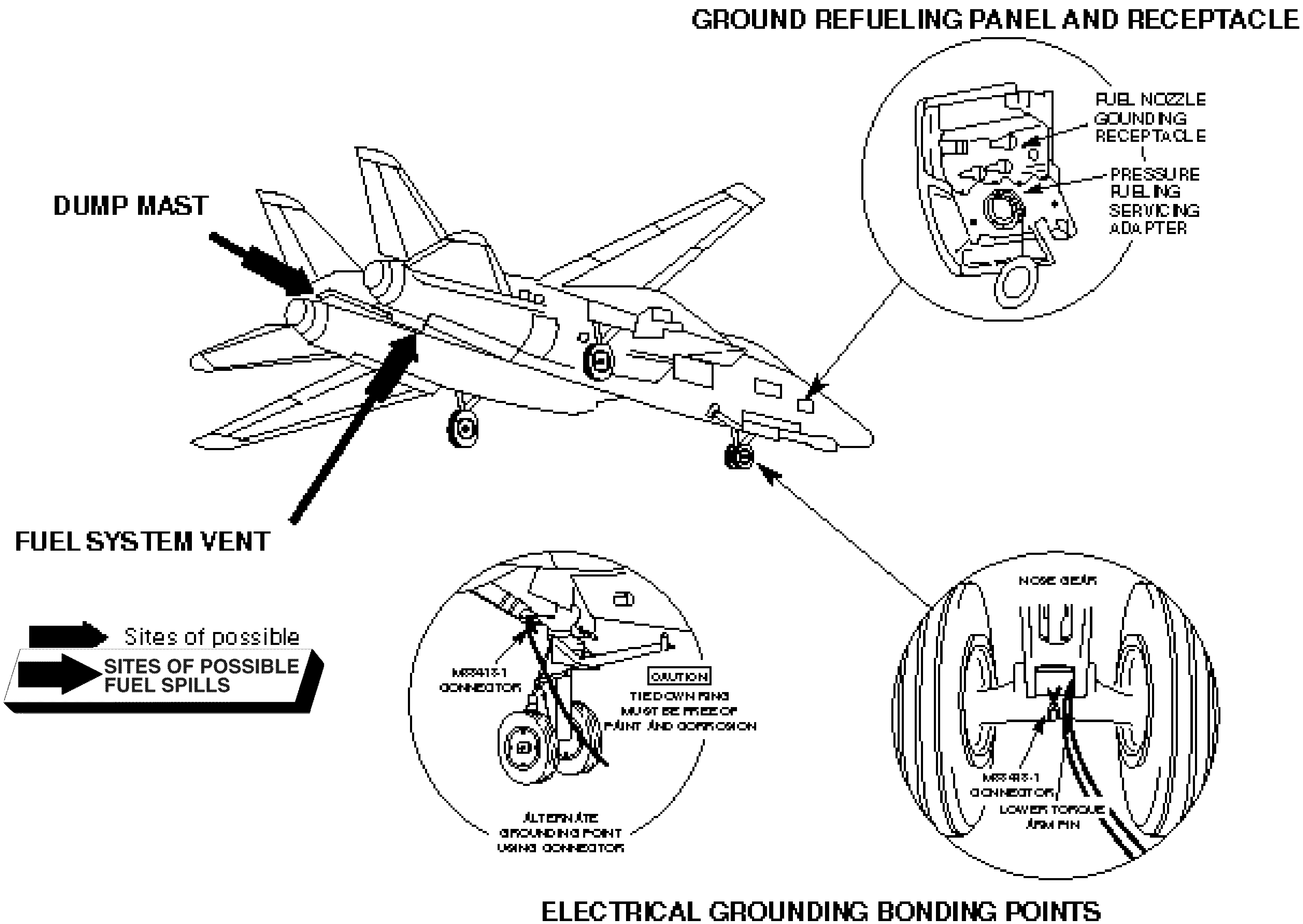
## APPENDIX C

## AIRCRAFT: EA-6

### PERSONNEL DANGER ZONES



# APPENDIX C
## AIRCRAFT: F-14
## AIRCRAFT CONFIGURATION



# APPENDIX C

# AIRCRAFT: F-14

## TABLE OF FUEL CAPACITIES

| Tank | | | Gallons |
|---|---|---|---|
| Internal | Fuselage | Forward | 691 |
| | | Aft | 648 |
| | | Right Feed | 235 |
| | | Left Feed | 221 |
| | Wing | Left | 295 |
| | | Right | 295 |
| | Total Internal | | 2,385 |
| Total External | | | 534 |
| Total Capacity | | | 2,919 |

## AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Wing Span<br>Spread<br>Folded | <br>64 ft 1½ in<br>38 ft 2½ in | Maximum Gross Weight — 74,349 lbs |
| Length | 62 ft 8½ in | Maximum Footprint — 314.5 psi |
| Height | 16 ft 1½ in | |

## F-14 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the F-14 aircraft, primarily the operation of the "precheck" system. In addition to these specialized procedures, the applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

1. Attach refueling nozzle to aircraft and place nozzle flow control handle in the open position.
2. Initiate fuel flow and observe vent pressure gage on ground refueling panel.

**CAUTION**

Immediately stop fuel flow if indicator moves to "STOP FUEL" or red position.

# APPENDIX C

# AIRCRAFT: F-14

3. Exercise precheck system by switching both the “FUSE TANKS” and “WING EXT TANKS” handles to the “STOP FUEL” position. Fuel flow into the aircraft should stop within a few seconds.

**CAUTION**

If fuel flow does not stop, discontinue refueling operation immediately. System failure should be investigated and resolved before hot refueling can be accomplished.

4. Return precheck handles to the “FUEL” position and continue fueling until aircraft tanks are filled and fuel flow automatically stops.

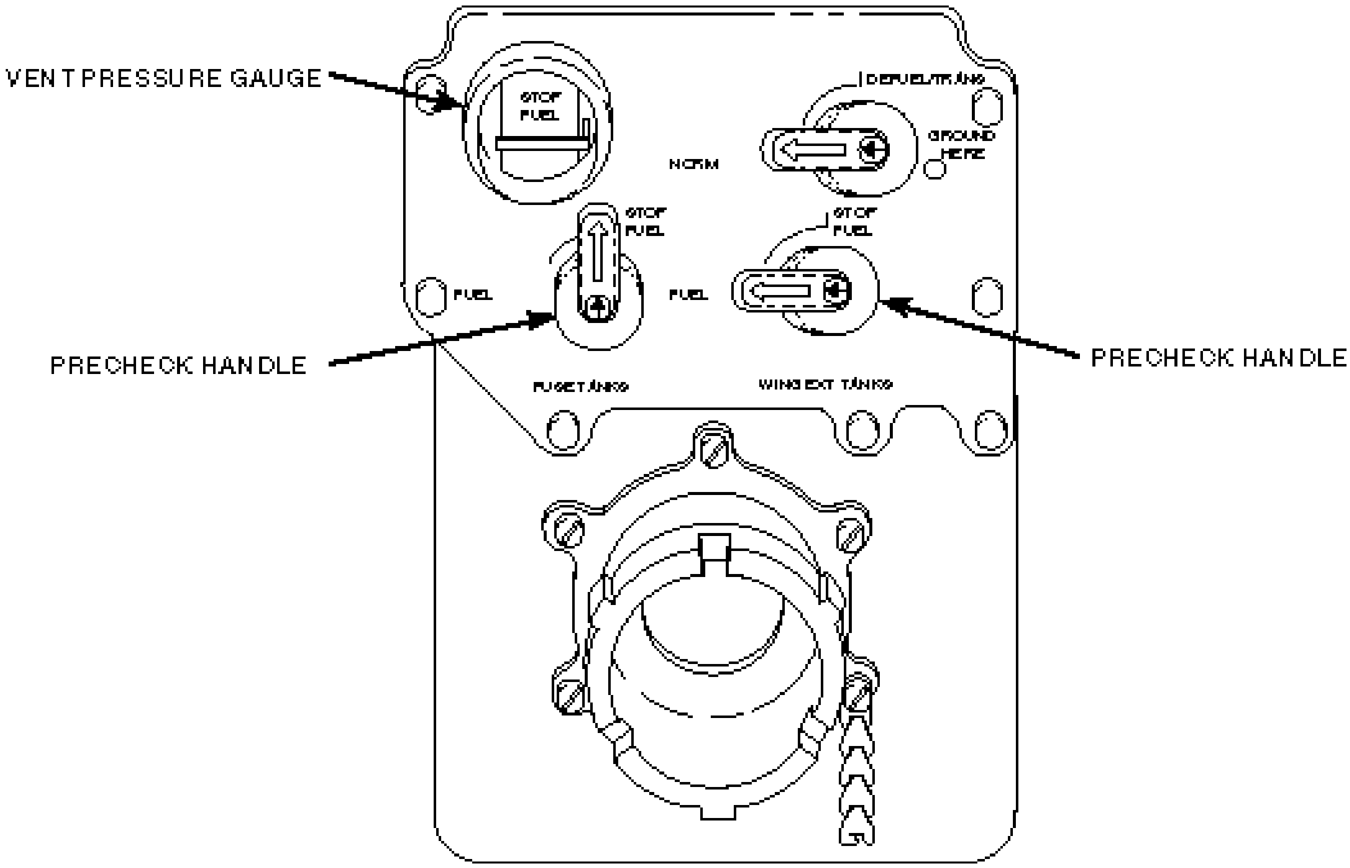
**SPECIAL NOTES — AIRCRAFT FUEL SYSTEM**

1. Under normal conditions, all air being displaced by fuel in the tanks, including external tanks, exits the aircraft through the common “Fuel System Vent.”
2. If any high level shut-off valves fail to operate correctly, fuel may spill from the “Fuel System Vent.”
3. A malfunction within the external fuel tanks may cause fuel to spill from the bottom center of the external tank (pressure relief vent).

# APPENDIX C

# AIRCRAFT: F-14

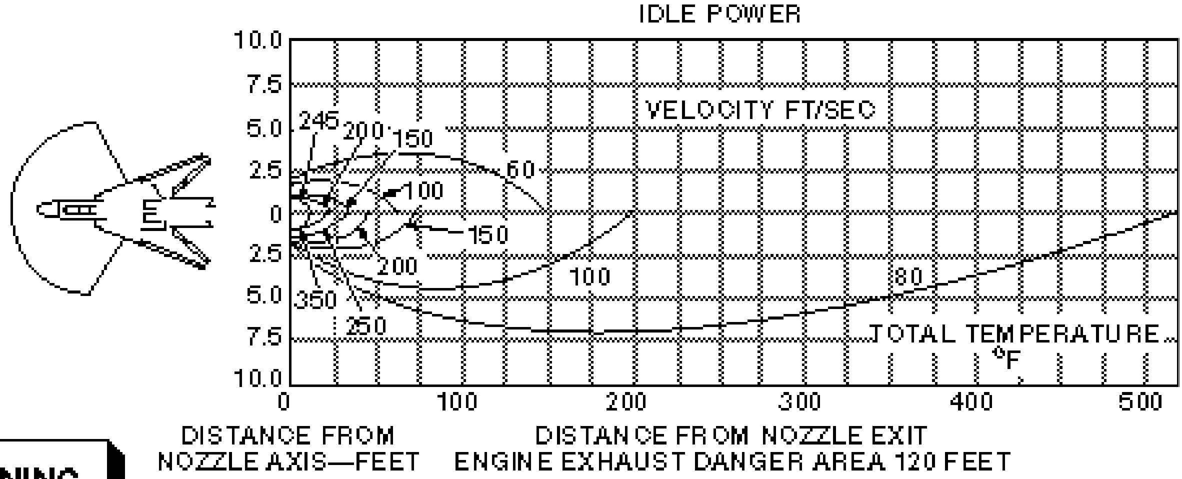
## GROUND REFUELING PANEL



# APPENDIX C

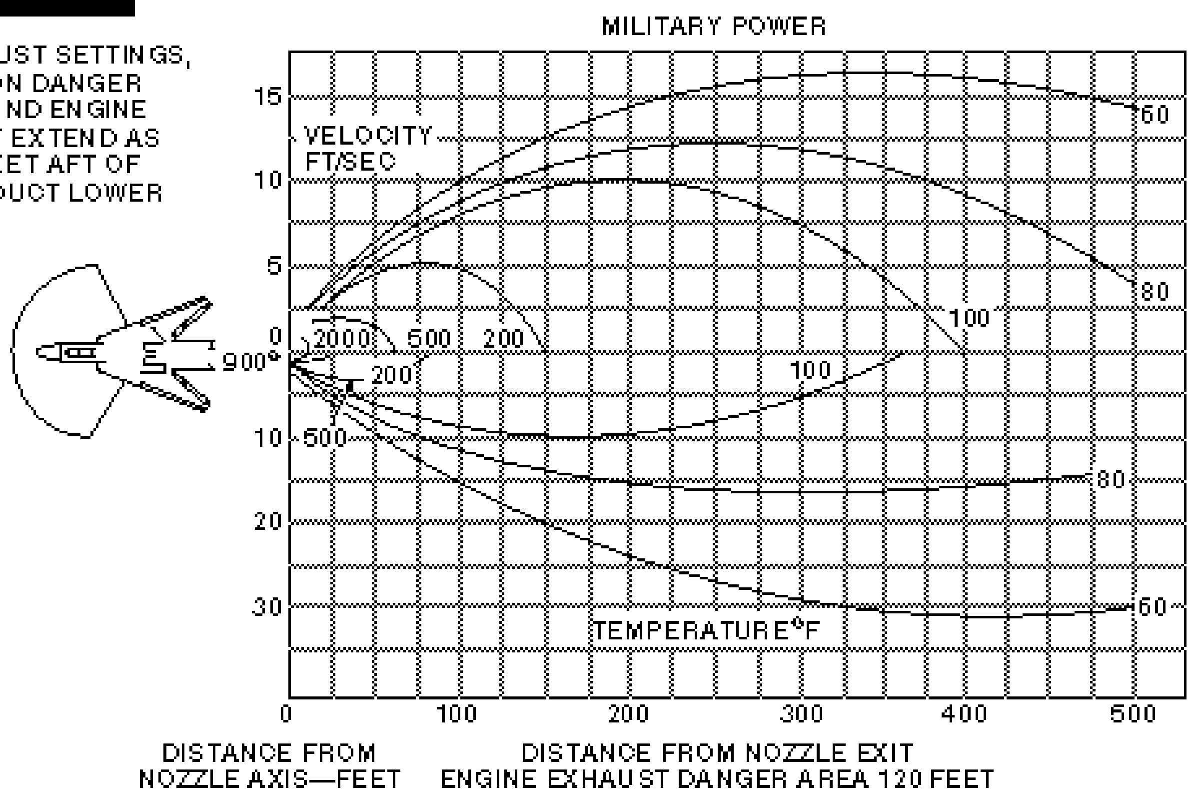
# AIRCRAFT: F-14

## PERSONNEL DANGER ZONES




**WARNING**

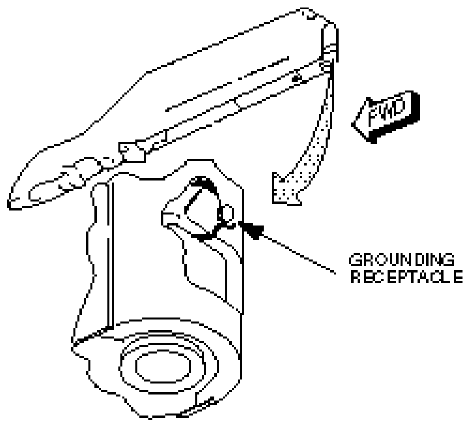
AT HIGH TRUST SETTINGS, THE SUCTION DANGER AREA AROUND ENGINE INLETS MAY EXTEND AS FAR AS 4 FEET AFT OF THE INLET DUCT LOWER DIP.



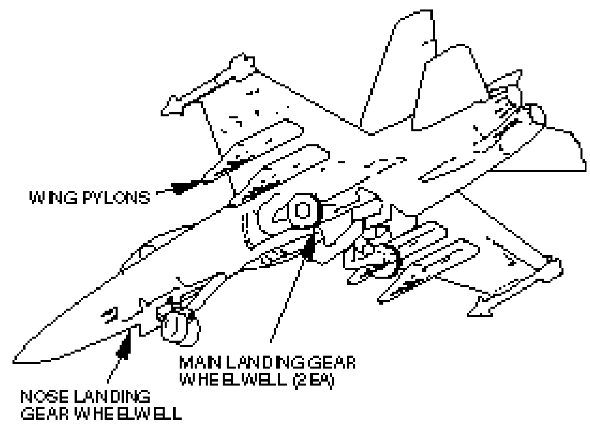
# APPENDIX C

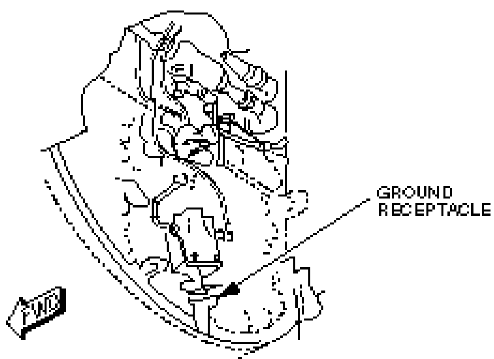
# AIRCRAFT: F/A-18A/B/C/D

## AIRCRAFT CONFIGURATION
## ELECTRICAL GROUNDING/BONDING POINTS

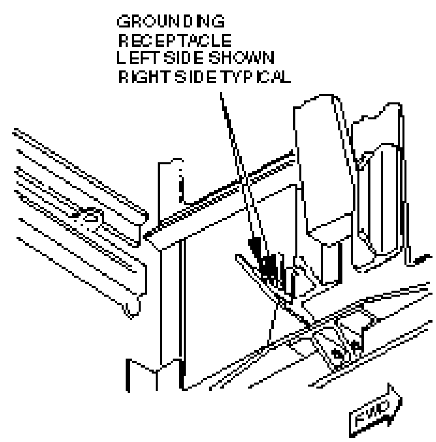



WING PYLONS




NOSE LANDING GEAR WHEELWELL

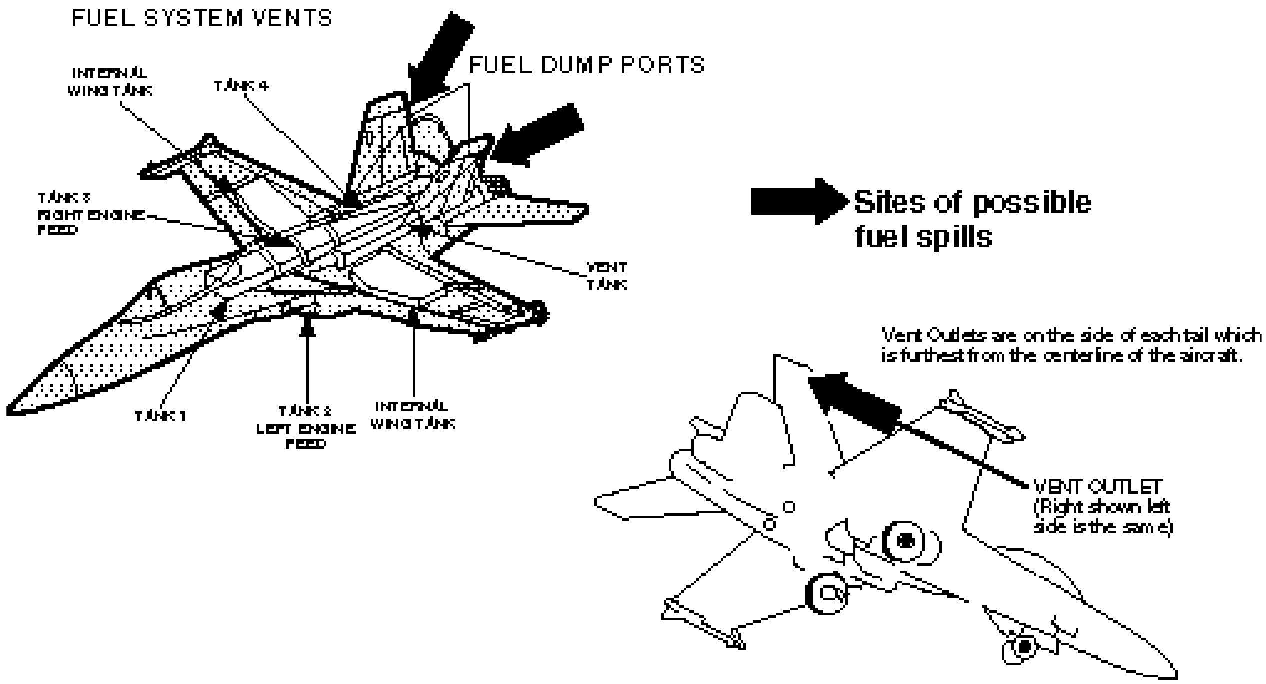



MAIN LANDING GEAR WHEELWELL

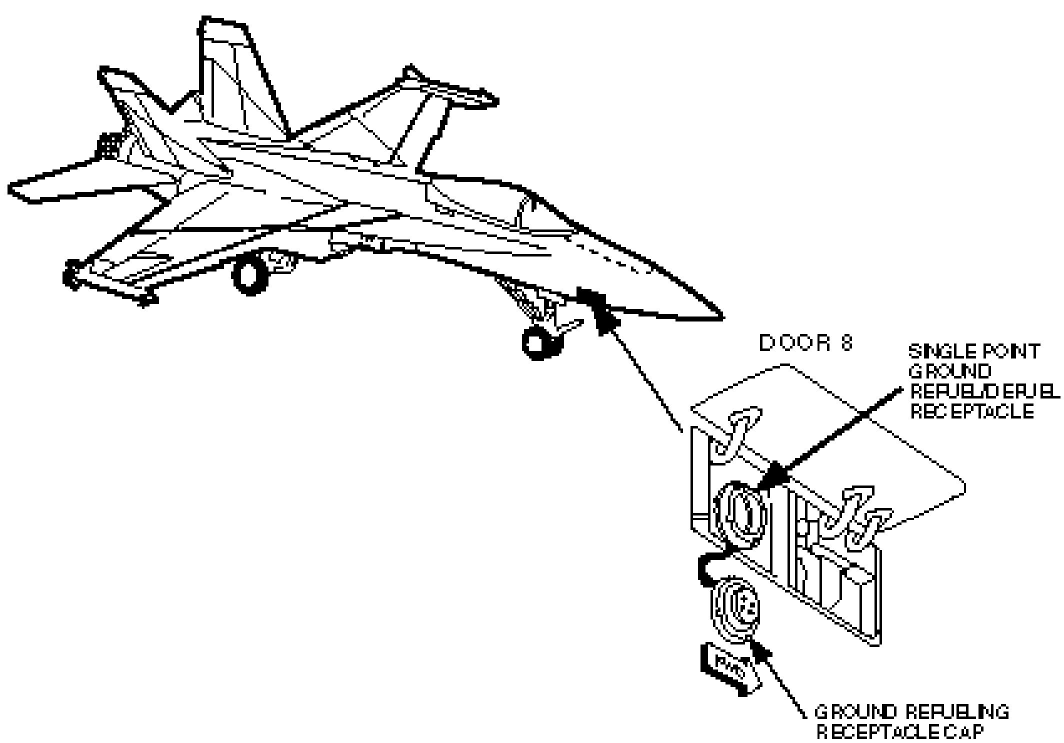
# APPENDIX C

# AIRCRAFT: F/A-18A/B/C/D

## AIRCRAFT CONFIGURATION
## LOCATION OF FUEL VENTS AND DUMP PORTS




## GROUND REFUELING PANEL AND RECEPTACLE



# APPENDIX C

## AIRCRAFT: F/A-18A/B/C/D

### TABLE OF FUEL CAPACITIES

| Tank | | | Gallons |
|---|---|---|---|
| Internal | Fuselage | Number 1 | 418 |
| | | Number 2 | 263 |
| | | Number 3 | 206 |
| | | Number 4 | 532 |
| | Wing | Left | 85 |
| | | Right | 85 |
| | Total Internal | | 1,589 |
| External | Elliptical Wing or Centerline Tank | | 314 |
| | Cylindrical Wing or Centerline Tank | | 330 |

### AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Wing Span<br>Spread<br>Folded | <br>40 ft 5 in<br>27 ft 6 in | Maximum Gross Weight — 51,900 lbs |
| Length | 56 ft | Maximum Footprint — 315 psi |
| Height | 15 ft 3 in | |

### F/A-18C/D REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the F-18A/B/C/D aircraft, primarily the operation of the "precheck" system. In addition to these specialized procedures, the applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

**CAUTION**

F-18 aircraft are normally hot refueled with both engines operating. DO NOT ASSUME RIGHT ENGINE TURNED OFF until confirmation obtained.

**Note**

Operation of the auxiliary power unit (APU) is prohibited during normal fueling.

# APPENDIX C

## AIRCRAFT: F/A-18A/B/C/D

1. Attach refueling nozzle to aircraft and place nozzle flow control handle in the open position.

2. Initiate fuel flow and observe tank pressure gauge on ground refueling panel.

**CAUTION**

Immediately stop fuel flow if tank pressure gauge indicates increasing pressure.

3. Exercise precheck system by moving the "Master Precheck Handle" into the up position. Observe "Fuel Flow Indicate" movement to verify that fuel flow into the aircraft stops.

   a. No external tanks installed. Fuel flow into the aircraft should stop in approximately 45 seconds.

   b. External tank(s) installed. Wait approximately 45 seconds, then press the "Ext Tk" button on the "Fuel Check Panel." Fuel flow into the aircraft should stop within approximately 10 seconds.

**CAUTION**

If fuel flow does not stop, discontinue refueling operation immediately. System failure should be investigated and resolved before hot refueling can be accomplished.

4. Return "Master Precheck Handle" to the down (off) position and continue fueling until aircraft tanks are filled and fuel flow automatically stops.

# APPENDIX C

# AIRCRAFT: F/A-18A/B/C/D

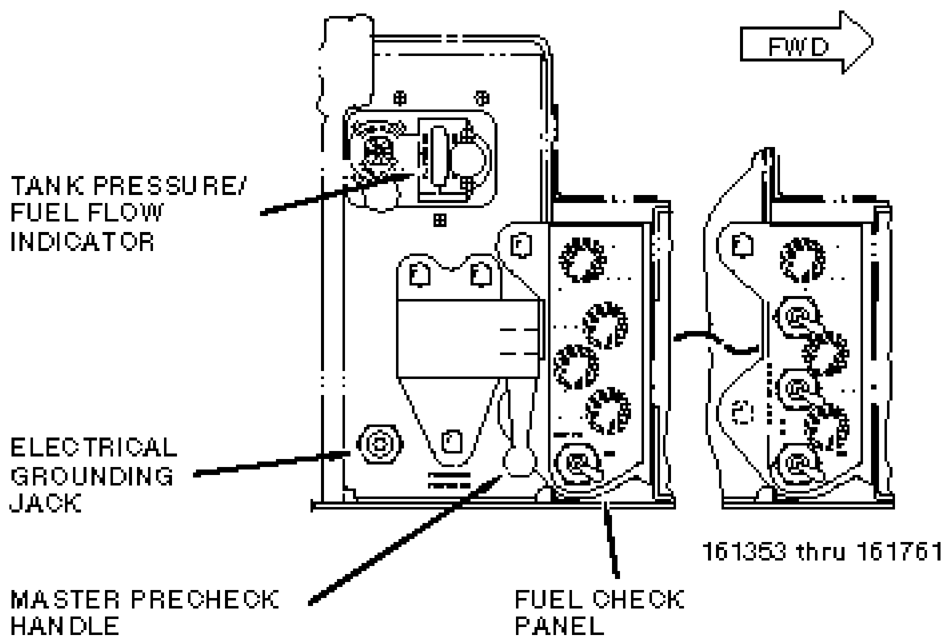
**SPECIAL NOTES — AIRCRAFT FUEL SYSTEM**

1. Under normal conditions, all air being displaced by fuel in the tanks, including external tanks, exits the aircraft through the common "Fuel System Vents."

2. If any high level shut-off valves fail to operate correctly, fuel may spill from the "Fuel System Vents."

3. A malfunction within an external fuel tank may cause fuel to spill from the bottom center of tank (pressure relief vent).

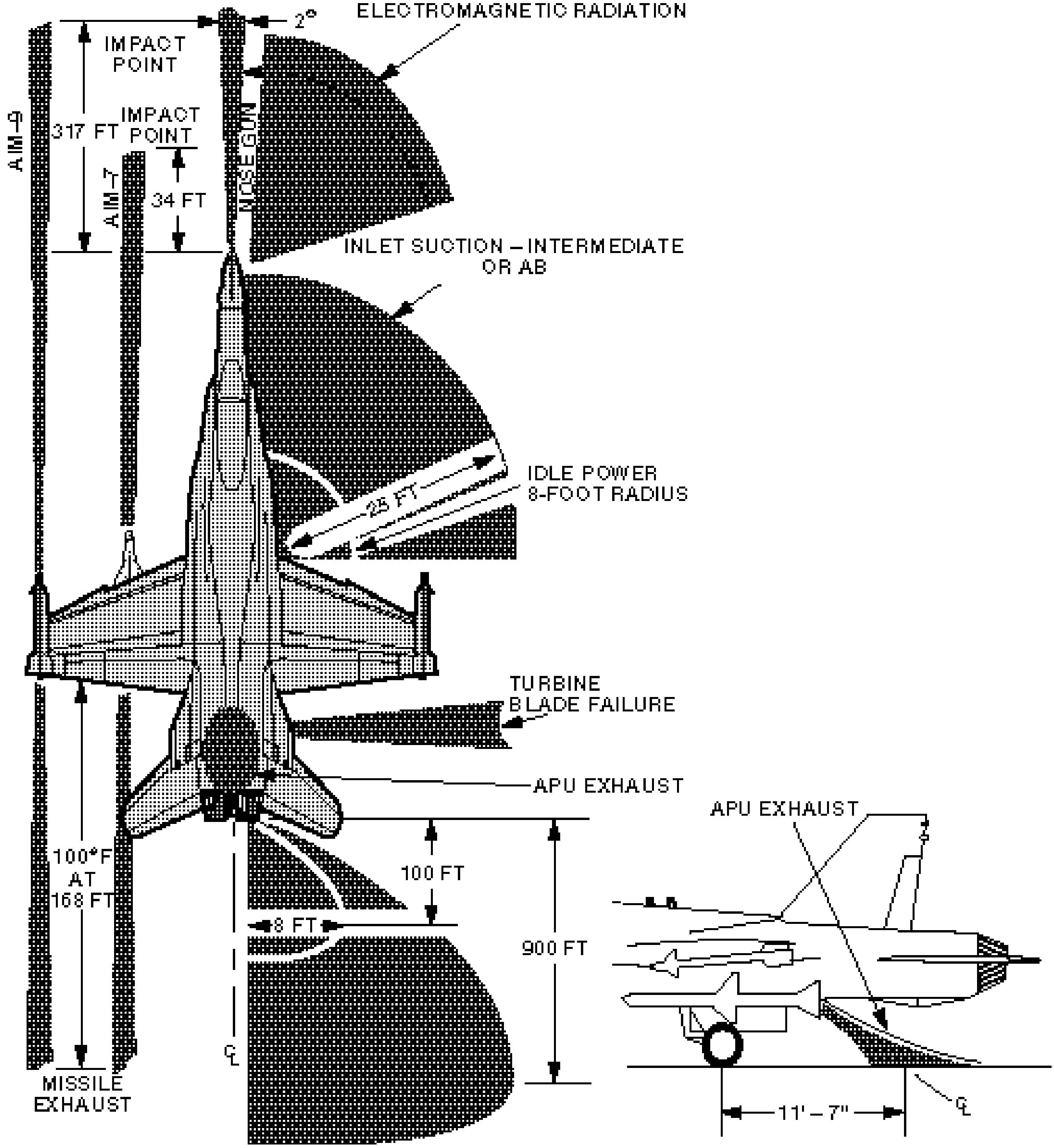
## GROUND REFUELING PANEL



# APPENDIX C

## AIRCRAFT: F/A-18A/B/C/D

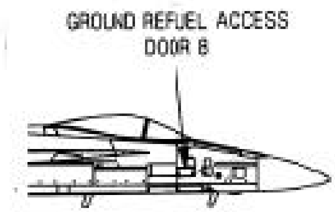
### PERSONNEL DANGER ZONE



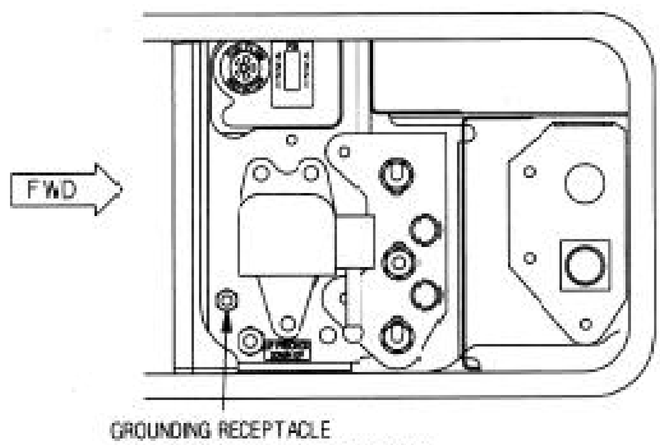
# APPENDIX C

# AIRCRAFT: F/A-18E/F

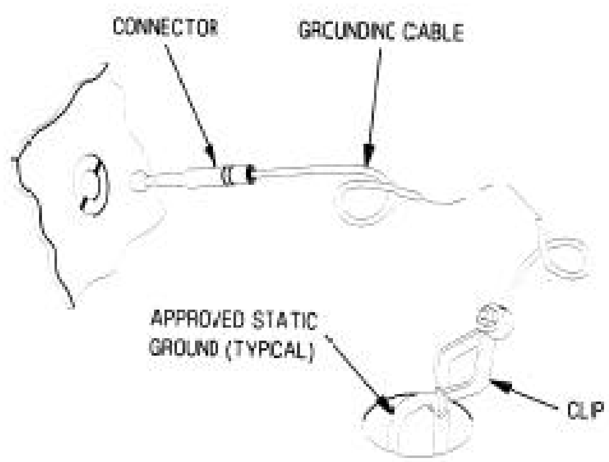
## AIRCRAFT CONFIGURATION
## ELECTRICAL GROUNDING/BONDING POINTS




RIGHT SIDE VIEW



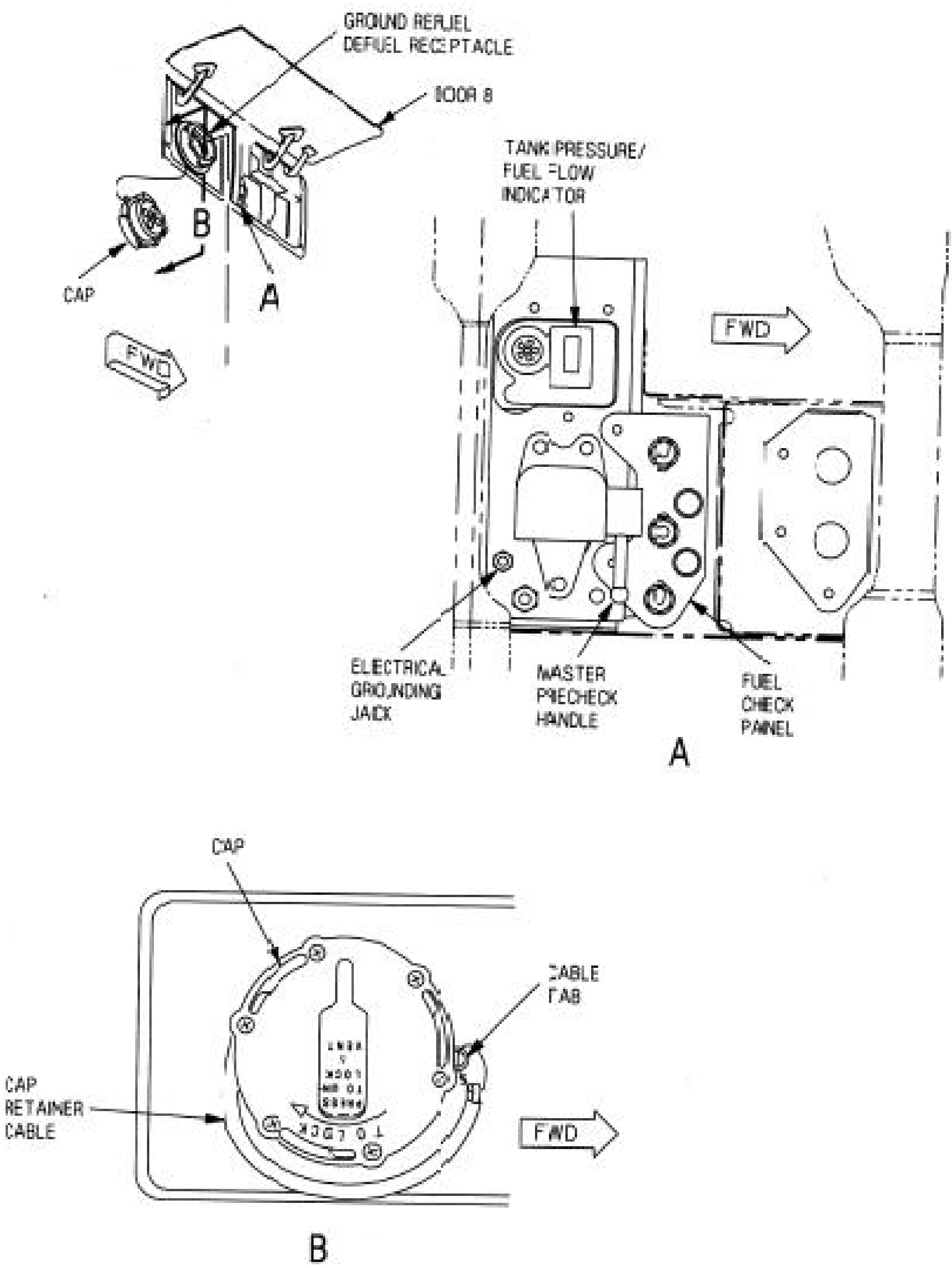

DOOR B



# APPENDIX C

# AIRCRAFT: F/A-18E/F

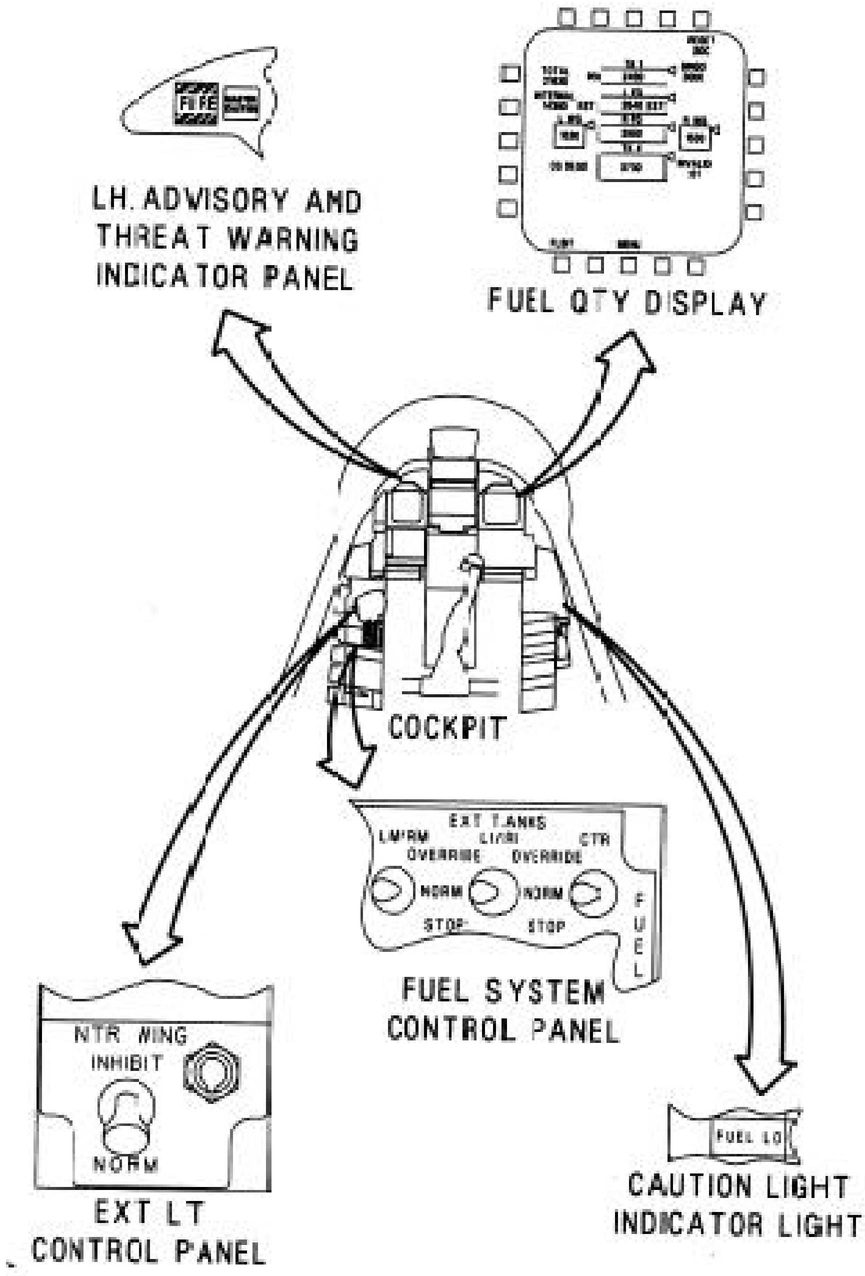
## AIRCRAFT CONFIGURATION
## REFUELING PANEL



## APPENDIX C

## AIRCRAFT: F/A-18E/F

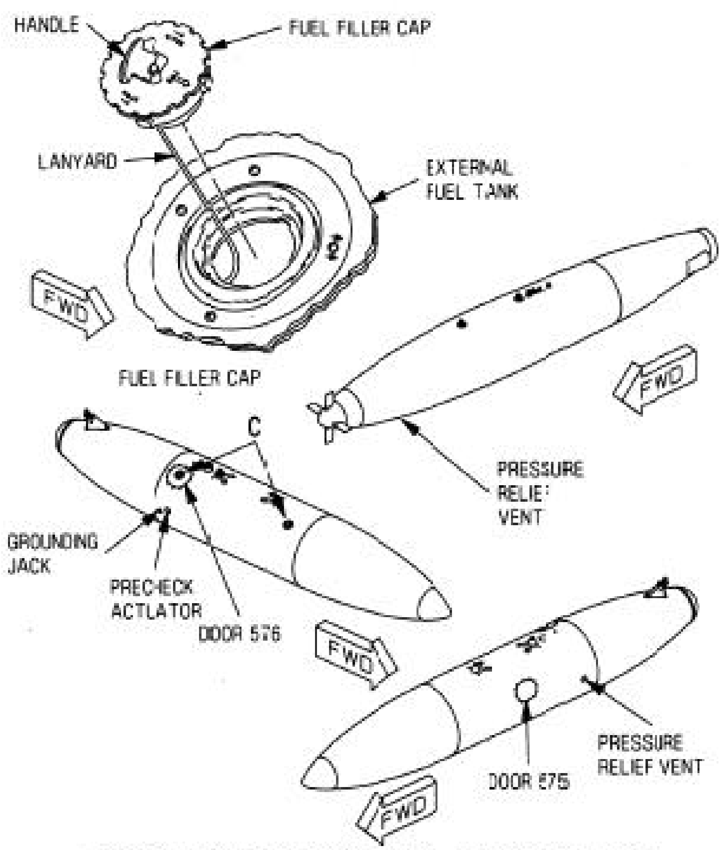
### AIRCRAFT CONFIGURATION
### COCKPIT CONTROLS FOR REFUELING



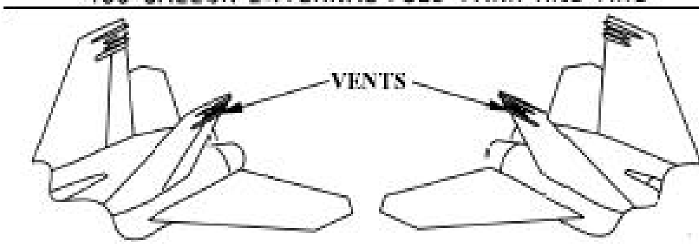
# APPENDIX C

# AIRCRAFT: F/A-18E/F

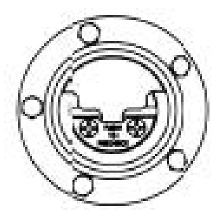
## AIRCRAFT CONFIGURATION
## DROP TANK INFO AND FUEL VENT LOCATIONS




480 GALLON EXTERNAL FUEL TANK AND ARS




LOCATION OF FUEL VENTS



480 GALLON TANK

# APPENDIX C

## AIRCRAFT: F/A-18E/F

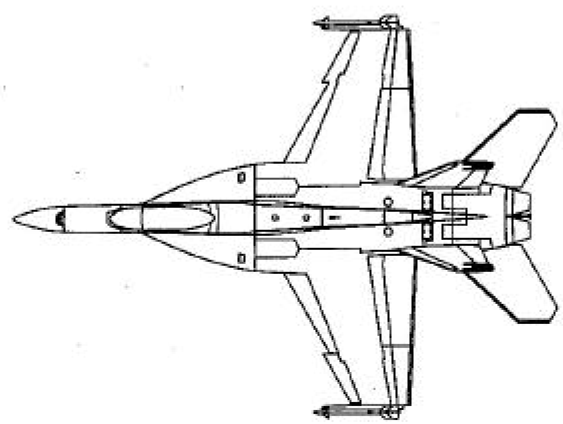
### TABLE OF FUEL CAPACITIES

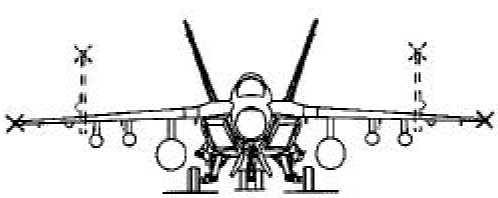
| Tank | | | Gallons |
|---|---|---|---|
| Internal | Fuselage | Number 1 (E) | 356 |
| | | Number 1 (F) | 216 |
| | | Number 2 | 401 |
| | | Number 3 | 403 |
| | | Number 4 | 569 |
| | Wing | Left | 254 |
| | | Right | 254 |
| | | Total Internal (E) | 2238 |
| | | Total Internal (F) | 2098 |
| External | | Drop Tank (s) | 480 per tank |

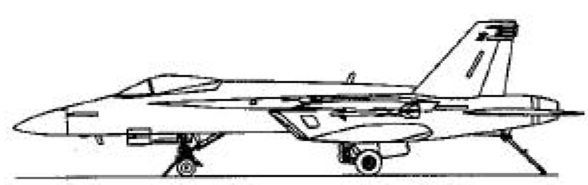
### AIRCRAFT CHARACTERISTICS

| | |
|---|---|
| SPAN (WING SPREAD) WITH MISSILES | 44 FEET 11 INCHES |
| WITHOUT MISSILES | 42 FEET 10 INCHES |
| SPAN (WINGS FOLDED) | 32 FEET 8 INCHES |
| LENGTH | 60 FEET 2 INCHES |
| HEIGHT (TO TOP OF FINS) | 16 FEET 0 INCHES |
| HEIGHT (TO TOP OF CLOSED CANOPY) | 10 FEET 8 INCHES |

GROSS WEIGHT: E - approx 31,55 lbs
F – approx 32,000 lbs







# APPENDIX C

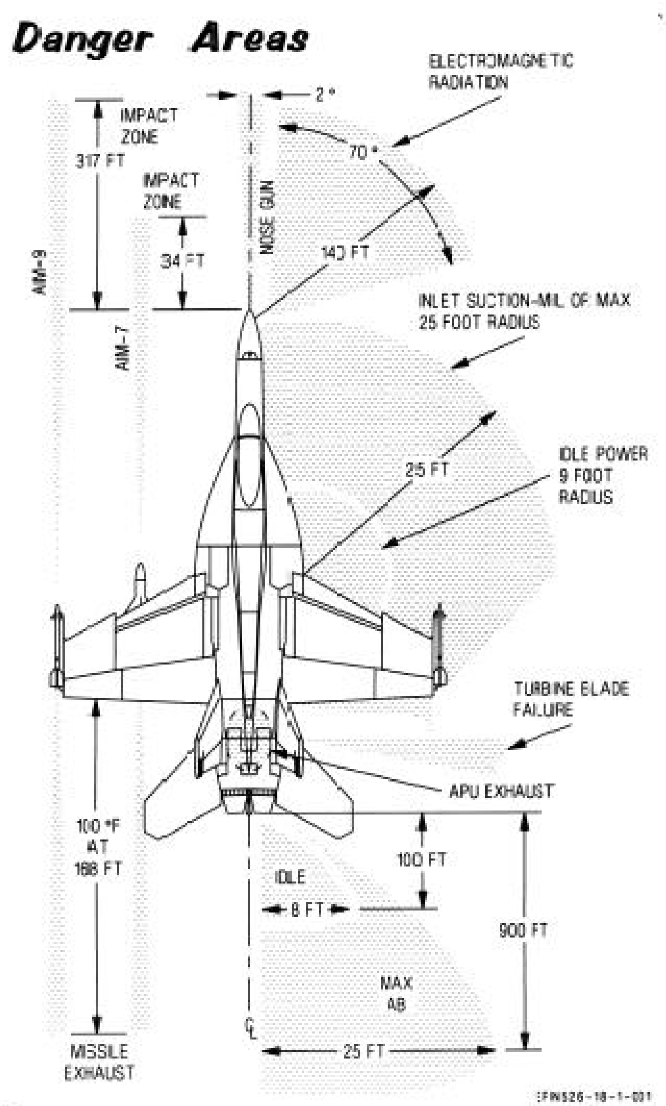
# AIRCRAFT: F/A-18E/F

## F/A-18E/F REFUELING PROCEDURES

1. Refer to the F/A-18E/F NATOPS Servicing Checklist (A1-F18EA-NFM-600) for refueling procedures.

2. In addition to the procedures in the above referenced manual, the applicable basic refueling procedures contained in Chapters 6, 12 or 18 of the Aircraft Refueling NATOPS Manual , NAVAIR 00-80T-109, should be followed.

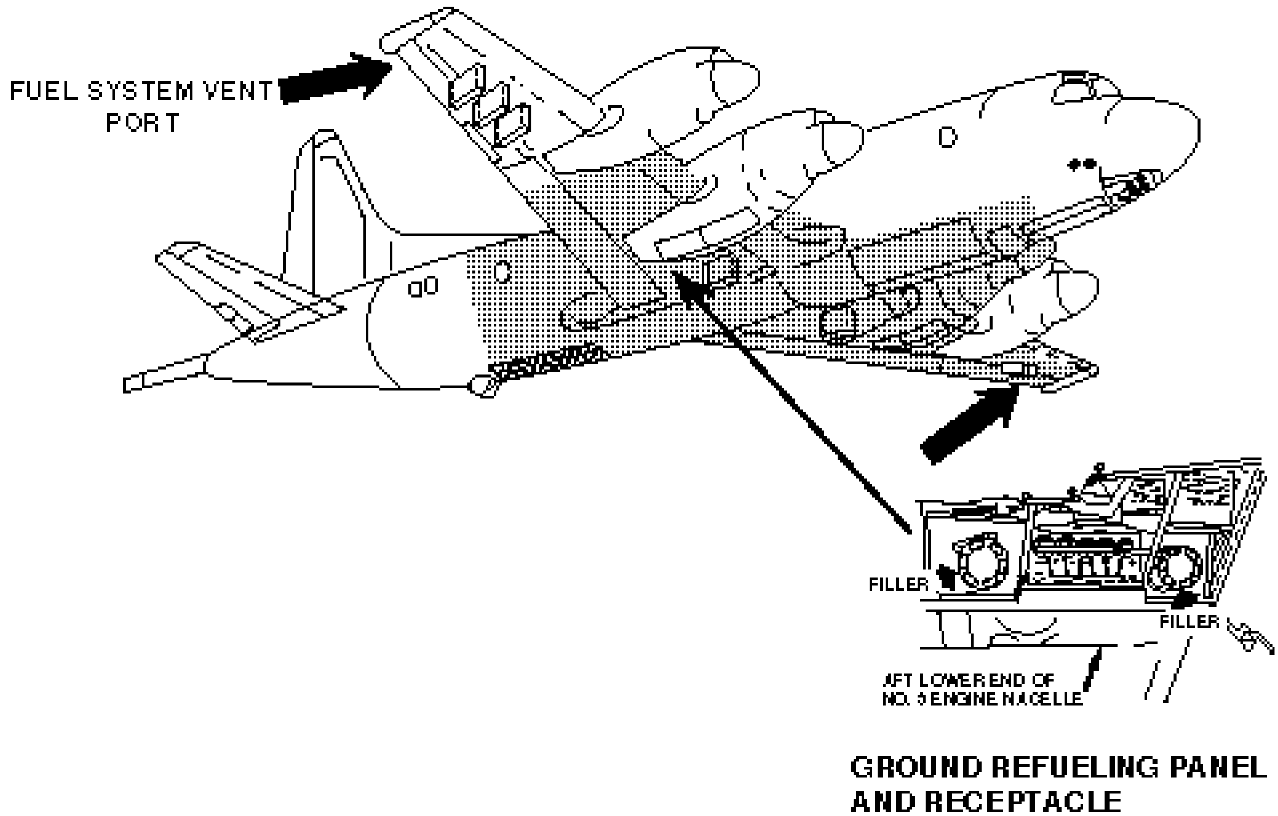
### PERSONNEL DANGER ZONE

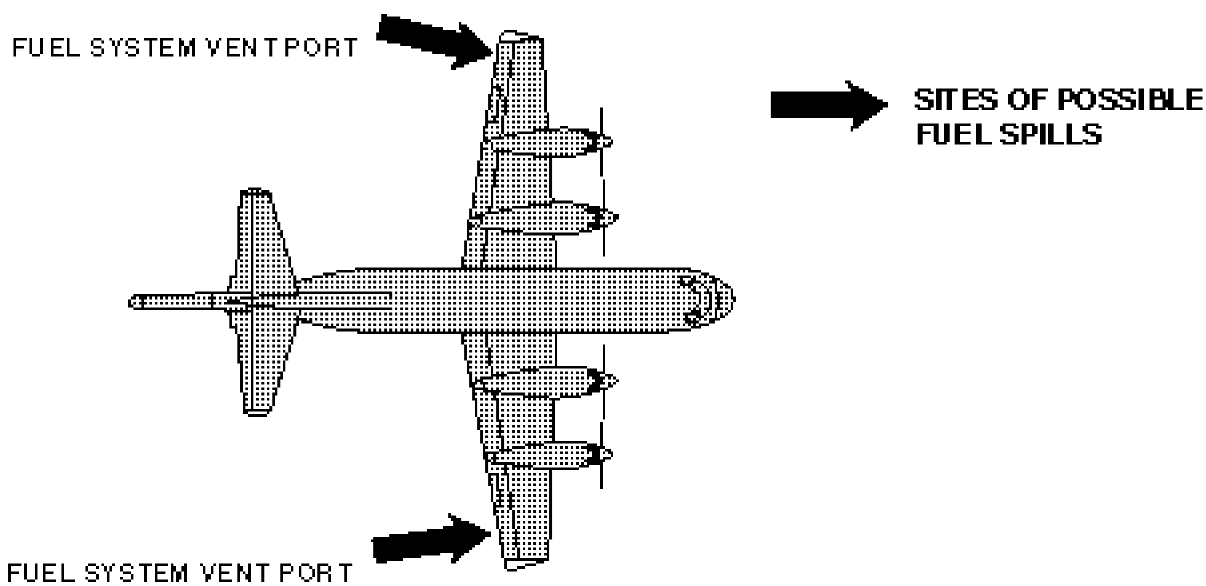


# APPENDIX C

# AIRCRAFT: P-3

## AIRCRAFT CONFIGURATION



# APPENDIX C

# AIRCRAFT: P-3

## TABLE OF FUEL CAPACITIES

| Tank | | Gallons |
|---|---|---|
| Outboard | No. 1 | 1,606 |
| | No. 4 | 1,606 |
| Inboard | No. 2 | 1,671 |
| | No. 3 | 1,671 |
| | No. 5 | 2,646 |
| | Total Internal | 9,200 |

## AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Wing Span | 99 ft 8in | Maximum Gross Weight — 139,760 lbs |
| Length | 116 ft 10 in | Maximum Footprint — 250 psi |
| Height | 34 ft 3 in | |

## P-3 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the P-3 aircraft, primarily the operation of the “precheck” system. In addition to these specialized procedures, the applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

1. Open Ground Refueling Panel access door.

2. Remove receptacle cap, attach refueling nozzle, open nozzle to the fully open and locked position, and initiate fuel flow.

**WARNING**

Ensure that air is venting from “FUEL SYSTEM VENTS.” If no venting is indicated, cease fueling operation immediately.

## APPENDIX C

## AIRCRAFT: P-3

3. Locate the Precheck system valve test switches on the ground refueling panel. Hold left “VALV CONT” switch to “PRI CLOSE” and the right “VALV CONT” switch to “SEC CLOSE.” Fuel flow into the aircraft should stop within a few seconds.

4. Release switches and fuel flow should resume.

5. Repeat the precheck process in step 3 above, this time holding the left “VALV CONT” switch to “PRI CLOSE.”

**CAUTION**

If fuel flow does not stop step 3 or 5 above, discontinue hot refueling operation immediately. System failure should be investigated and resolved before hot refueling can be accomplished.

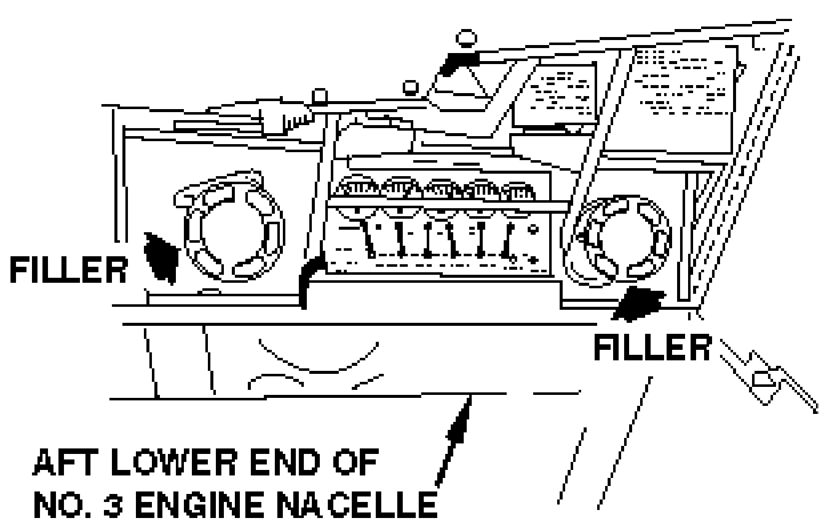
6. Release switches and refuel aircraft until fuel flow into the aircraft stops and the fuel quantity gauge on the ground refueling panel indicates the tanks are full.

### SPECIAL NOTES — AIRCRAFT FUEL SYSTEM

1. Under normal conditions, all air being displaced by fuel in the tanks exits the aircraft through the common “Fuel System Vent Ports,” which are located on each side of aircraft.

2. If any high level shut-off valves fail to operate correctly, fuel may spill from one of the “Fuel System Vent Ports.” In addition, the fuel tanks, which are located in the Stubwings, may rupture and spill fuel.

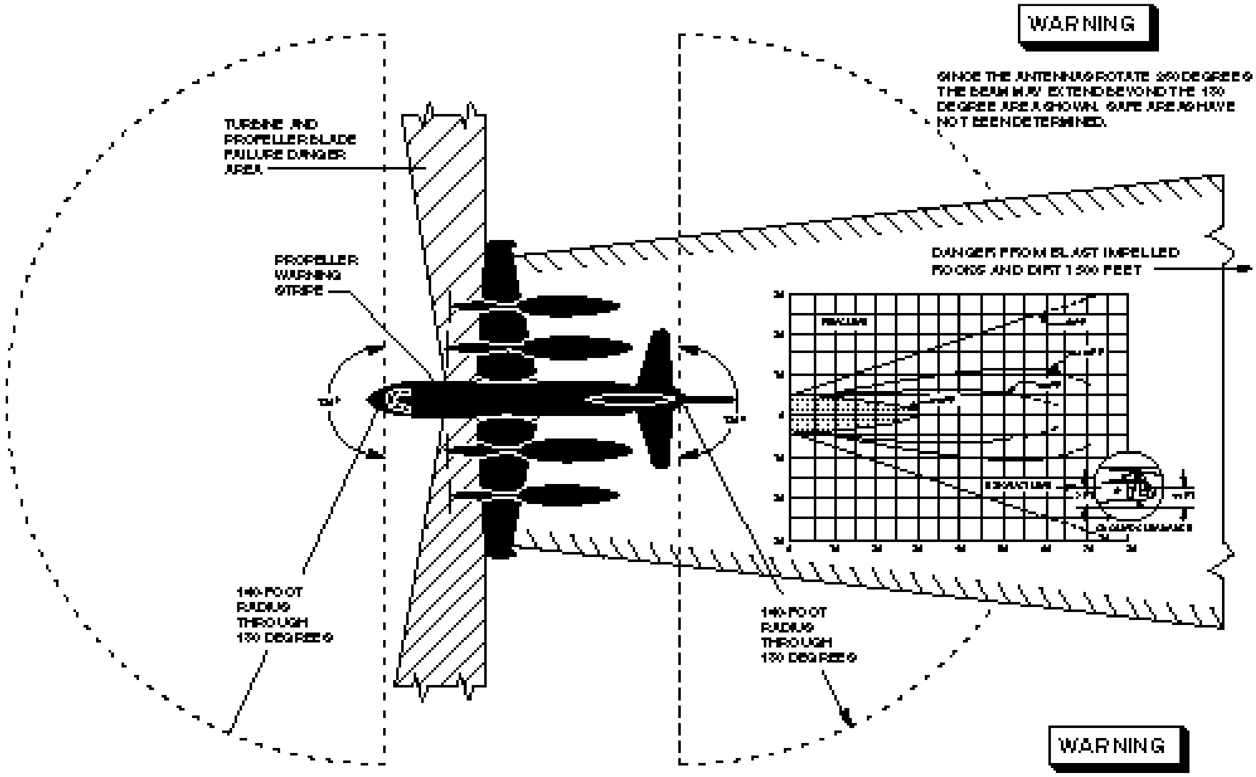
**GROUND REFUELING PANEL**

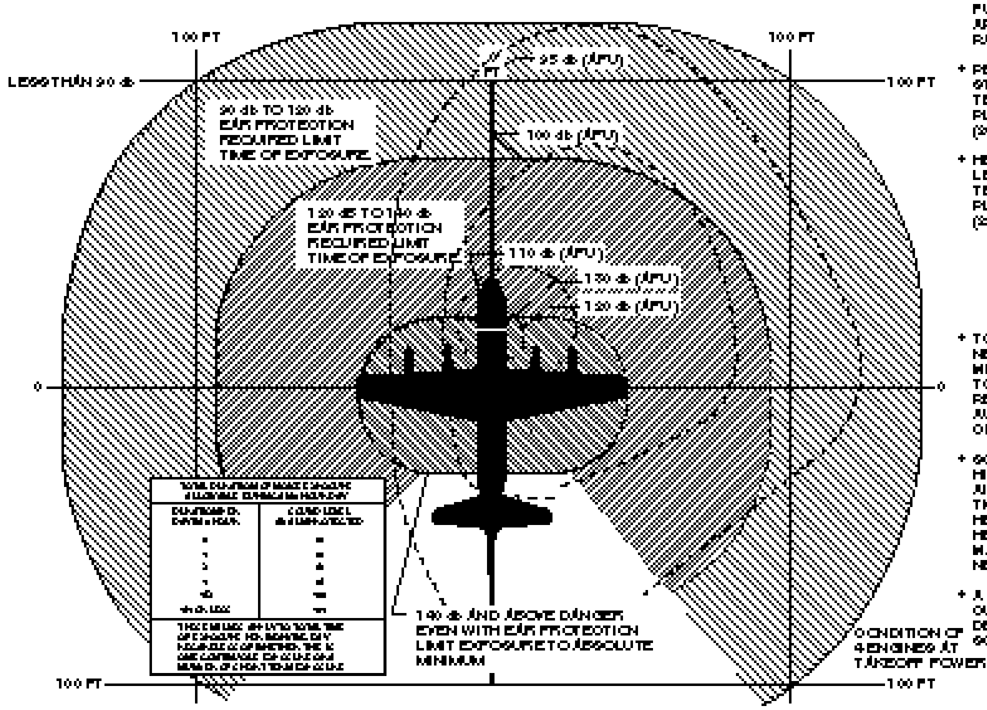


# APPENDIX C

# AIRCRAFT: P-3

## PERSONNEL DANGER ZONES




WARNING

- DO NOT APPLY HIGH VOLTAGE TO RADAR ANTENNA WITH ANT/DUMMY LOAD SWITCH IN ANT POSITION WHEN FUEL TRUCKS OR FUELING OPERATIONS ARE WITHIN A RADIUS OF 140 FEET FROM RADAR ANTENNA.
- PERSONNEL MUST BE WARNED TO STAY 75 FEET FROM A RADAR ANTENNA, WHEN HIGH VOLTAGE IS APPLIED AND ANTENNA IS SELECTED. (200 FEET FOR THE AN/APS-137 (V) 2)
- HERO ORDNANCE MUST REMAIN AT LEAST 140 FEET FROM THE ANTENNA WHEN HIGH VOLTAGE IS APPLIED AND ANTENNA IS SELECTED. (250 FEET FOR THE AN/APS-137 (V) 2)

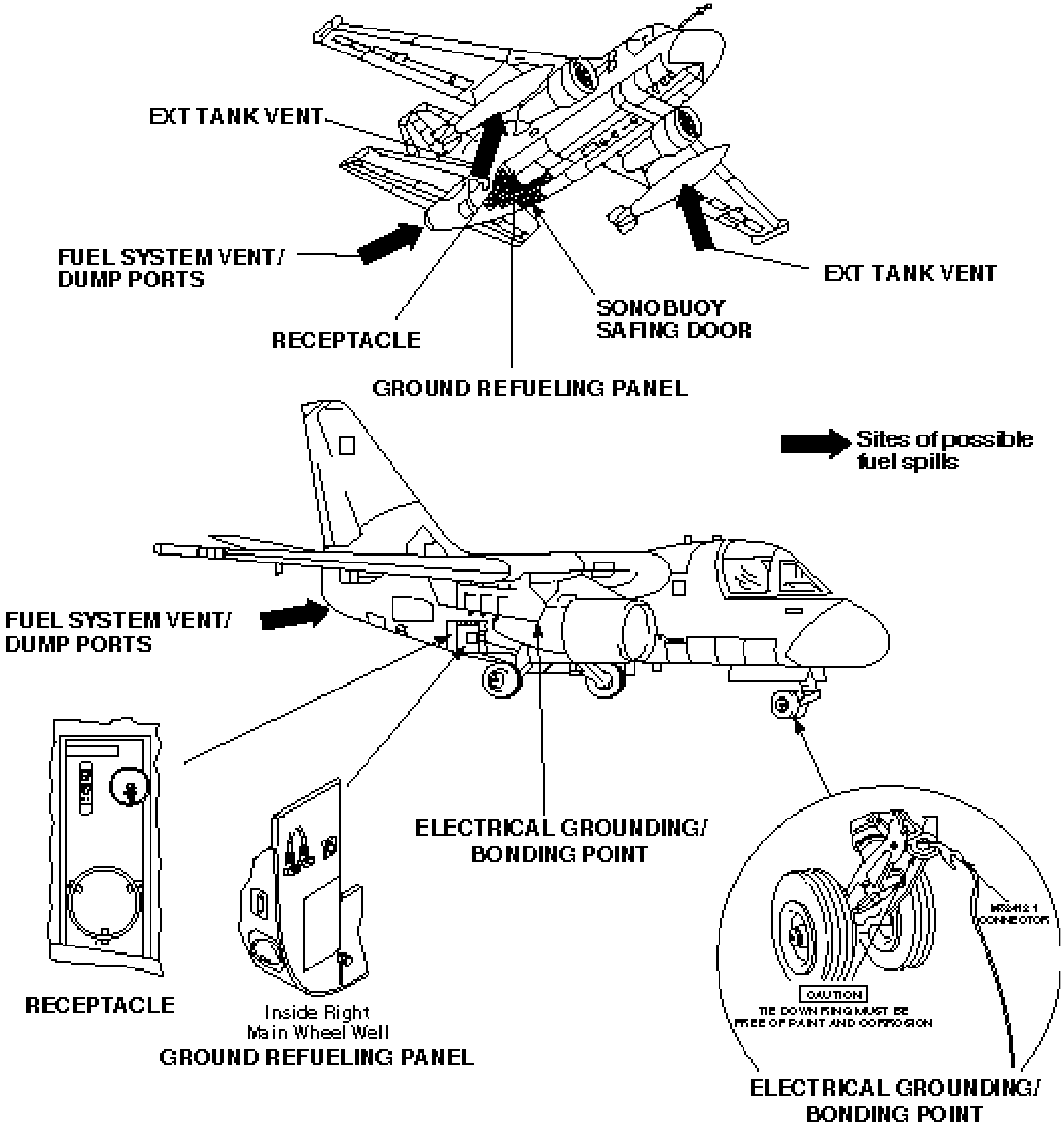
NOTE

- TO ACCURATELY ASSESS THE EFFECTIVENESS OF HEARING CONSERVATION MEASURES ALL PERSONNEL EXPOSED TO NOISE HAZARDOUS AREAS SHOULD RECEIVE ROUTINE MONITORING AUDIOMETRY IN ACCORDANCE WITH OPNAVINST 6260.6 SERIES
- SOUND INTENSITY LEVELS OF 85 dBA AND HIGHER HAVE BEEN RECORDED INSIDE P-3 AIRCRAFT DURING FLIGHT. CONSIDERATION SHOULD BE GIVEN TO WEARING HEARING PROTECTION WHILE OFF HEADSET. AS UNPROTECTED EXPOSURE MAY RESULT IN TEMPORARY OR PERMANENT HEARING LOSS
- A COMBINATION OF INSERT AND CIRCUMAURAL HEARING PROTECTION DEVICES SHOULD BE UTILIZED WHEN SOUND LEVELS EXCEED 100 dBA.

# APPENDIX C

## AIRCRAFT: S-3

### AIRCRAFT CONFIGURATION



# APPENDIX C

## AIRCRAFT: S-3

### TABLE OF FUEL CAPACITIES

| Tank | | Gallons |
|---|---|---|
| Internal | Left Feed | 176.5 |
| | Right Feed | 176.5 |
| | Left Transfer | 790.0 |
| | Right Transfer | 790.0 |
| | Total Internal | 1,933.0 |
| External | Left Pylon | 265.0 |
| | Right Pylon | 265.0 |
| Total | Internal + External | 2,463.0 |

### AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Wing Span<br>Spread<br>Folded | <br>68 ft 8 in<br>29 ft 6 in | Maximum Gross Weight — 50,000 lbs |
| Length | 53 ft 4 in | Maximum Footprint — 288 psi |
| Height | 22 ft 9 in | |

### S-3 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the S-3 aircraft, primarily the operation of the “precheck” system. In addition to these specialized procedures, the applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

**CAUTION**

Sonobouy Safing Door should be opened to ensure that the jettison system has been disarmed.

# APPENDIX C

## AIRCRAFT: S-3

1. Attach refueling nozzle to aircraft and place nozzle flow control handle in the open position.

2. Initiate fuel flow and observe “TANK PRESSURE INDICATOR GAUGE” on ground refueling panel (inside the right main landing gear wheel well).

**CAUTION**

Immediately stop fuel flow if indicator moves into the red band labeled “STOP REFUELING.”

3. Exercise precheck system by twisting and holding both “PRECHECK VALVES” on the ground refueling panel in the “OPEN” position. Fuel flow into the aircraft should stop within 20 seconds.

**CAUTION**

If fuel flow does not stop, discontinue refueling operation immediately. System failure should be investigated and resolved before hot refueling can be accomplished.

4. “PRECHECK VALVES” are spring-loaded to the “CLOSED” position. Release them and continue fueling until aircraft tanks are filled and fuel flow automatically stops.

5. If external tanks are installed, they can be refueled by turning the “EXTERNAL TANK FUELING SWITCH” to the “ON” position. This switch should be placed in the “ON” position only after the high level shutoff valves in the internal tanks have been tested using the “PRECHECK VALVES” in steps 3 and 4 above. Return this switch to the “OFF” position at the conclusion of the refueling operation.

### SPECIAL NOTES — AIRCRAFT FUEL SYSTEM

1. Under normal conditions, all air being displaced by fuel in the internal tanks exits the aircraft through the common “Fuel System Vent Port.”

2. If any high level shutoff valves fail to operate correctly, fuel may spill from the “Fuel System Vent Port” and/or tank(s) may rupture.

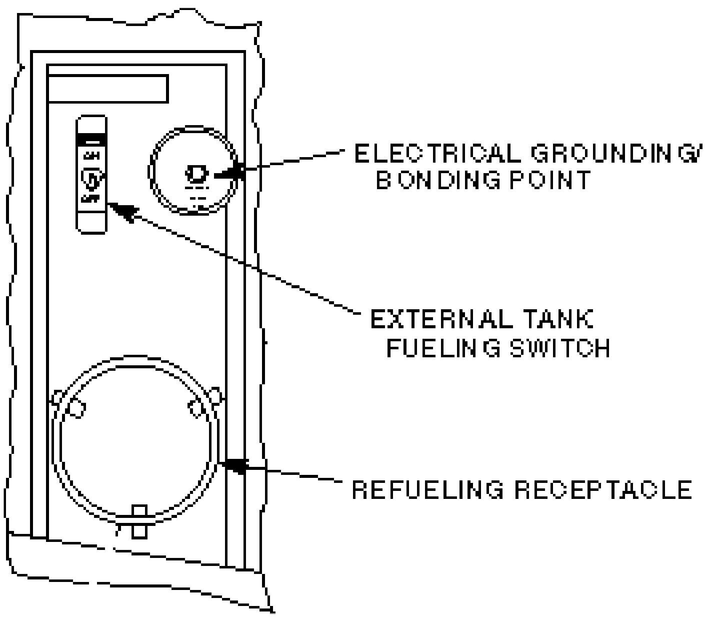
3. A malfunction within the external fuel tanks may cause fuel to spill from the bottom center of the external tank (pressure relief vent).

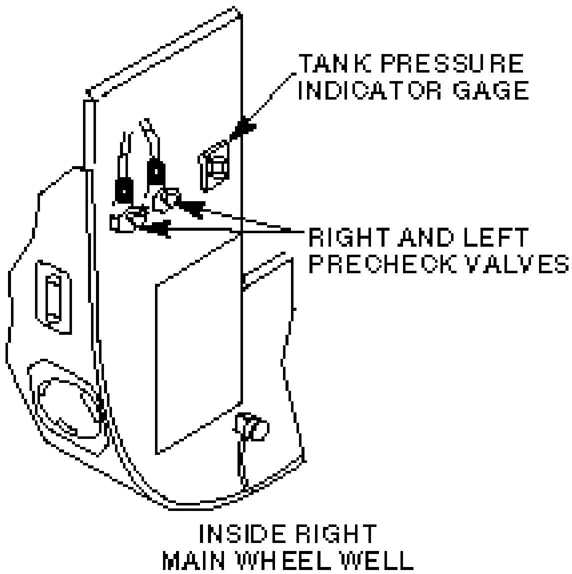
4. The Precheck system does not exercise the high level shutoff valves in the external tanks.

# APPENDIX C

# AIRCRAFT: S-3

## GROUND REFUELING PANEL

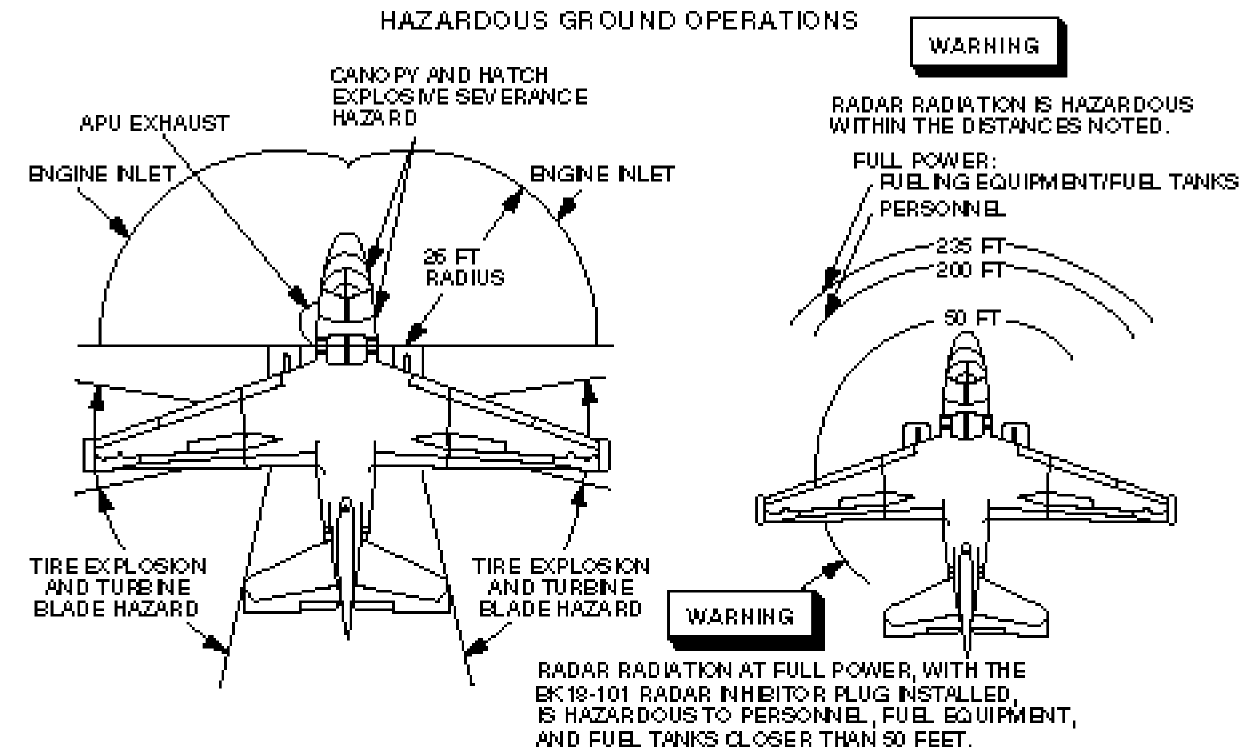


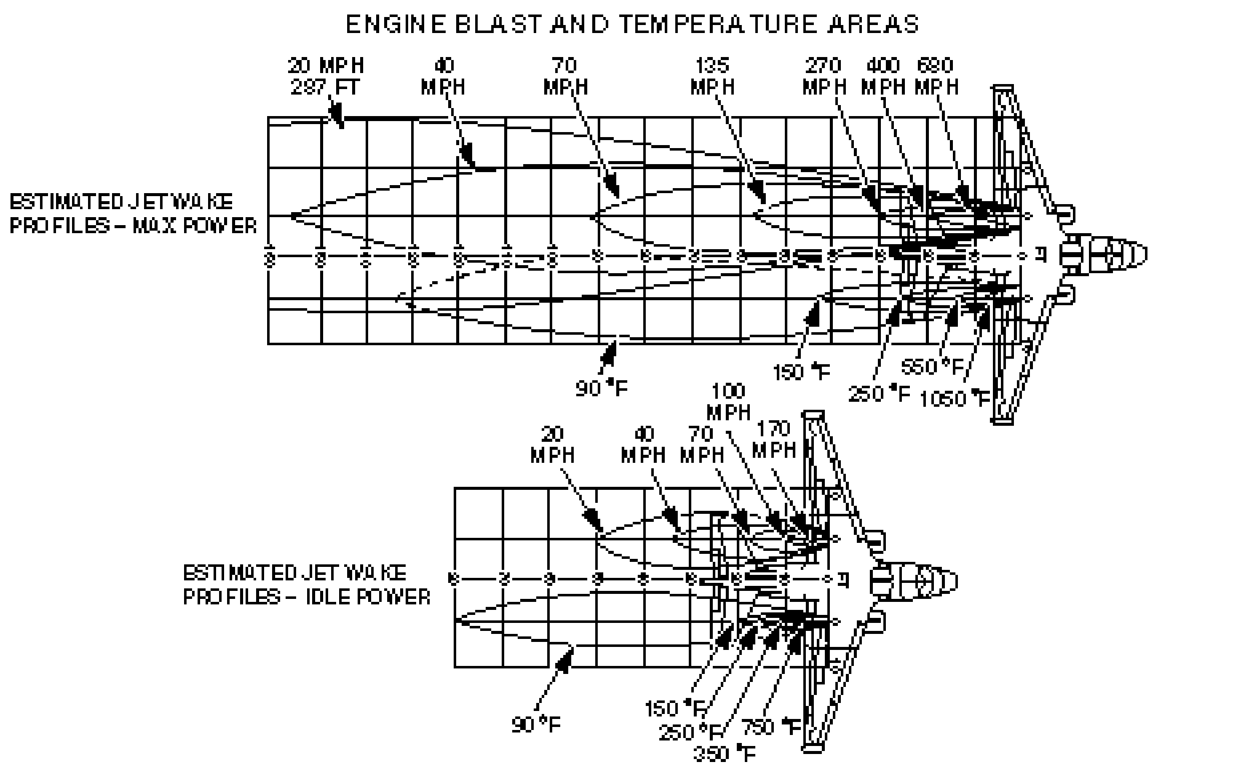



# APPENDIX C

# AIRCRAFT: S-3

## PERSONNEL DANGER ZONES

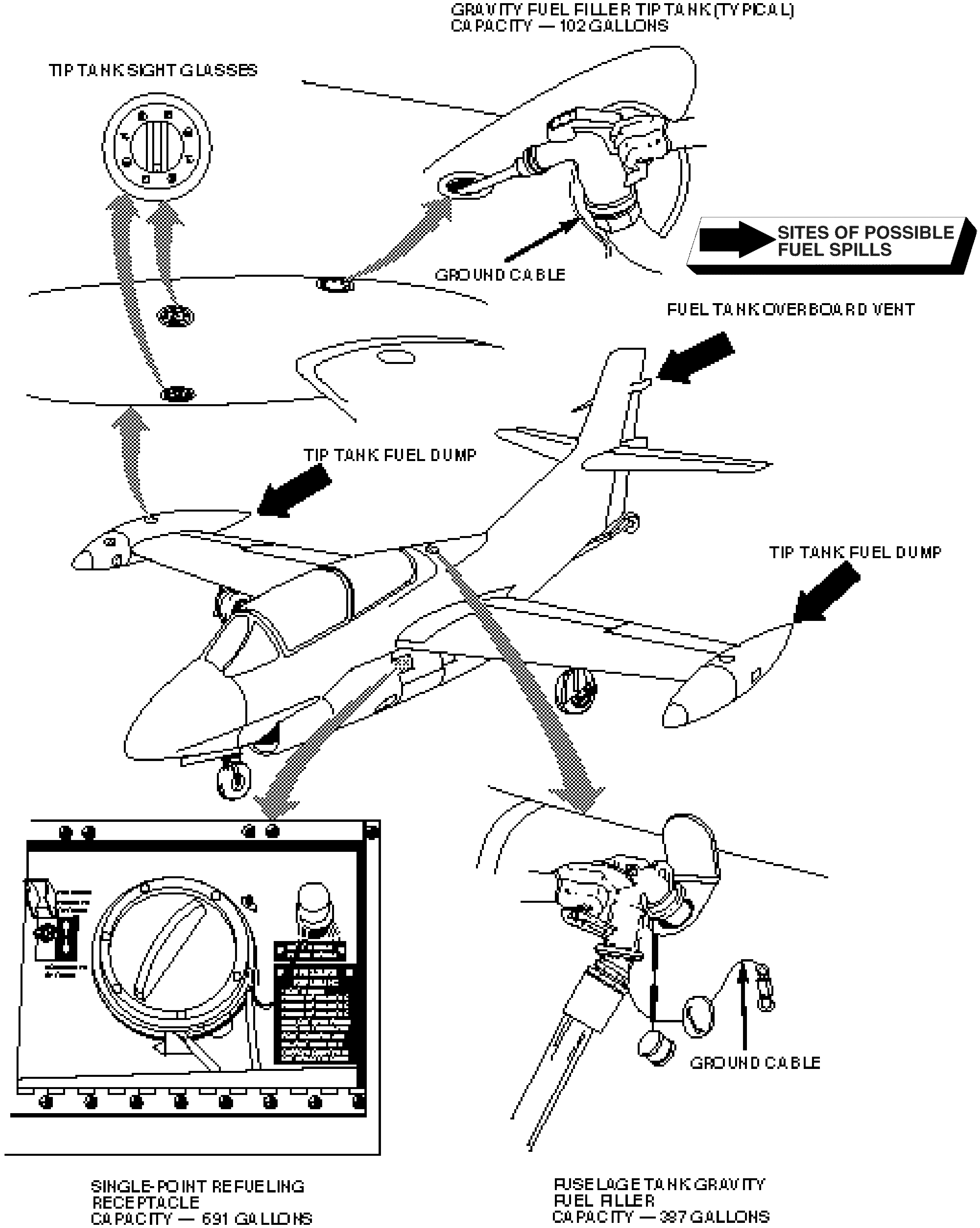


# APPENDIX C

# AIRCRAFT: T-2

## AIRCRAFT CONFIGURATION



# APPENDIX C

# AIRCRAFT: T-2

## TABLE OF FUEL CAPACITIES

| Tank | Gallons |
|---|---|
| Fuselage | 387 |
| Wing Leading Edge | 50 (Each) |
| Tip | 102 (Each) |
| Total | 691 |

## AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Wing Span | 38 ft 1 in | Maximum Gross Weight — 14,000 lbs |
| Length | 38 ft 3 in | Maximum Footprint — 150 psi |
| Height | 14 ft 8 in | |

## T-2 REFUELING PROCEDURES

The following procedures cover only those refueling procedures that are unique to the T-2 aircraft, primarily the operation of the “pre-check” system.

### PRE-CHECK PROCEDURE

1. Prepare aircraft and refueling system in accordance with the applicable procedure in Chapter 6, 12, or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109.

2. Initiate refueling.

3. Move TIP TANKS switch to HOLD if not refueling tip tanks, or check switch at REFUEL if refueling tip tanks (aircraft 156722 and subsequent aircraft with AFC-132 incorporated.)

4. Refuel the tanks with fuel. Test the level control valves during the first minute of refueling as follows:

   a. Position TEST switch to PRIMARY & TIP TANKS. Fuel flow should stop (hose jerk) within 5 seconds.

   b. Position TEST switch to SECONDARY & TIP TANKS. Fuel flow should stop (hose jerk) within 5 seconds.

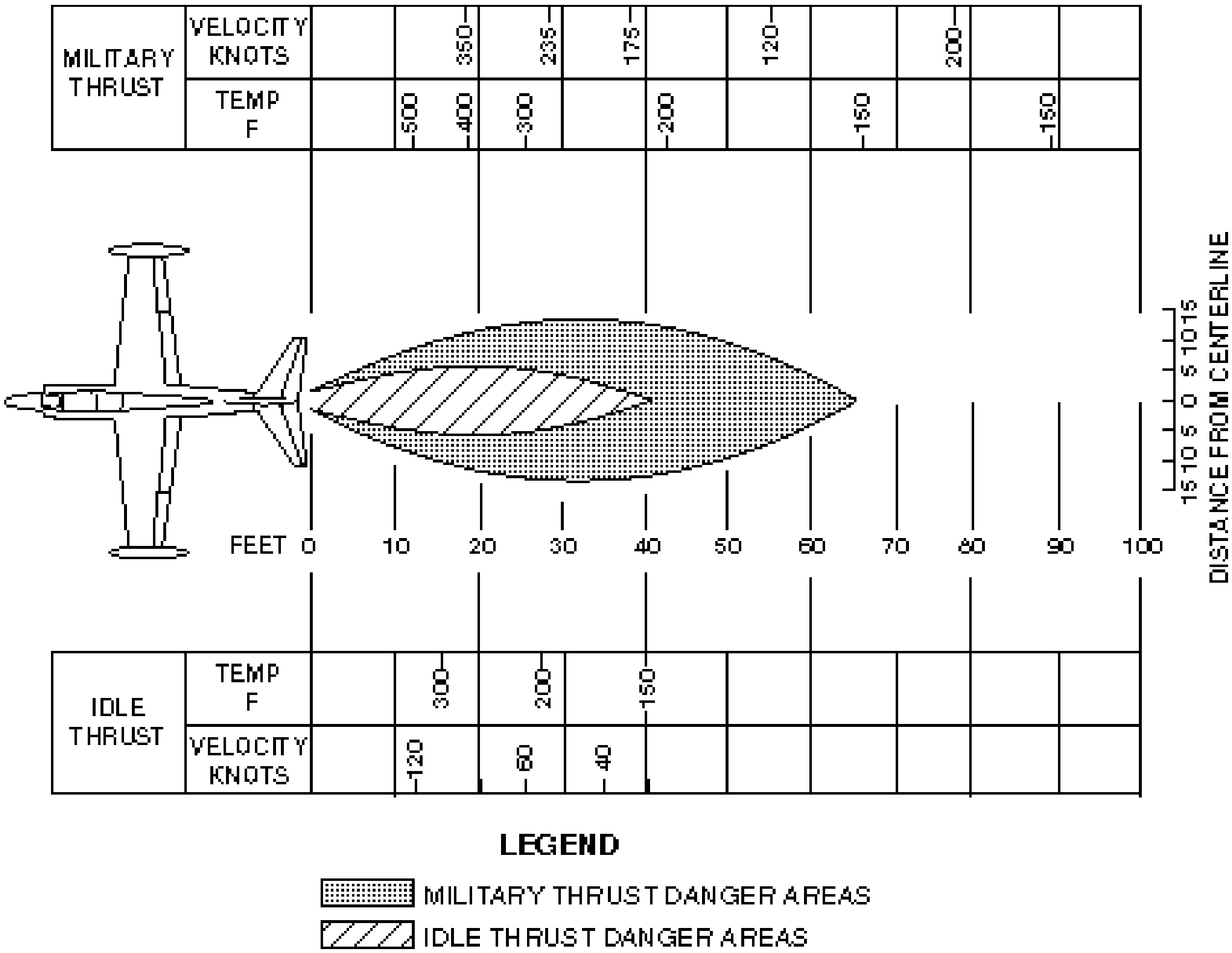
**CAUTION**

Do not hold TEST switch in either position more than 30 seconds.

# APPENDIX C

## AIRCRAFT: T-2

### PERSONNEL DANGER ZONES




**WARNING**

Personnel required to be in the vicinity of a jet aircraft, while the engine is running, should be familiar with U.S.N. safety precautions OPNAV 34 P1, BUMED INST. 6260-6A and all local directives pertaining to protection while in areas of high engine temperatures and sound.

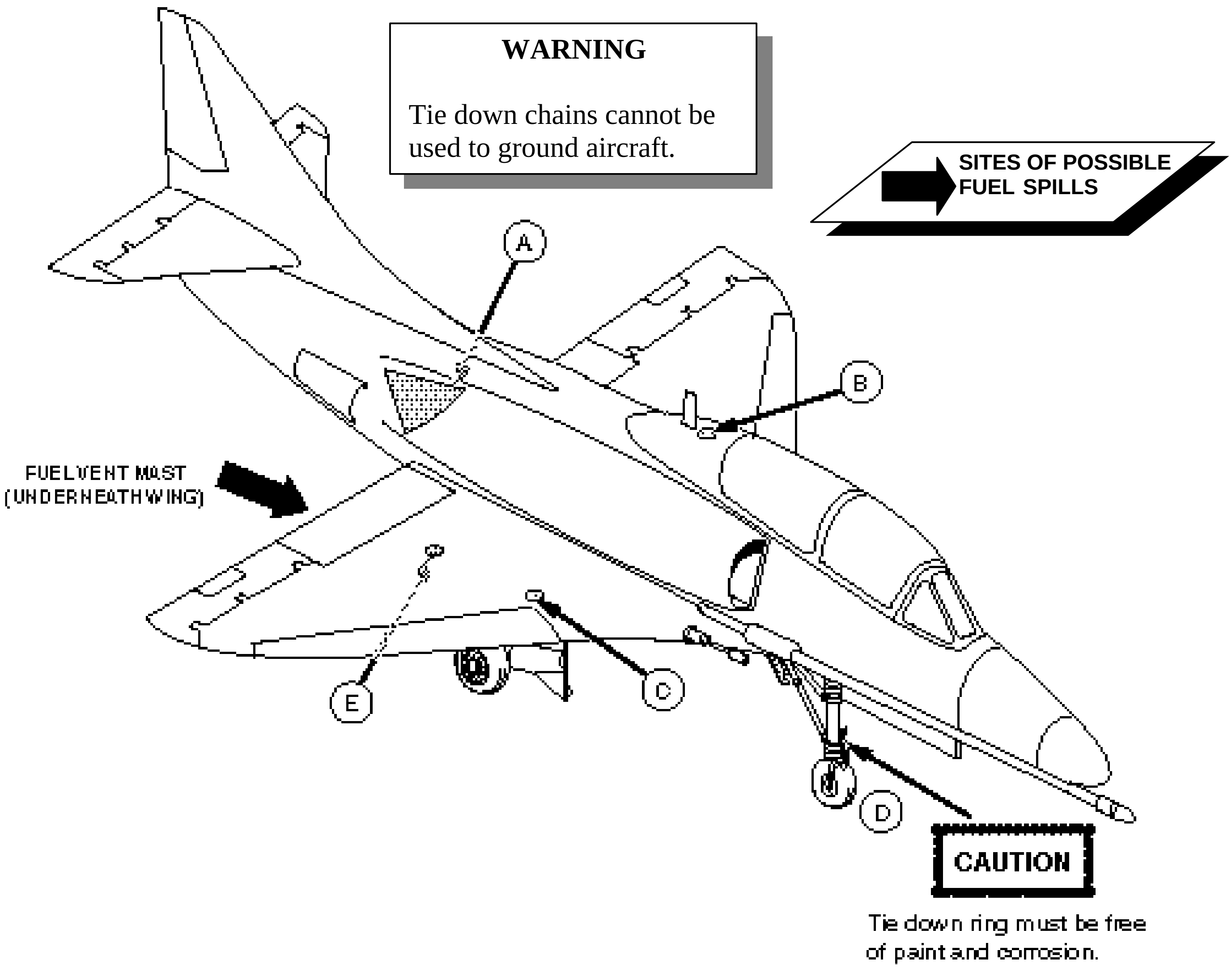
## APPENDIX C

## AIRCRAFT: TA-4

## AIRCRAFT CONFIGURATION

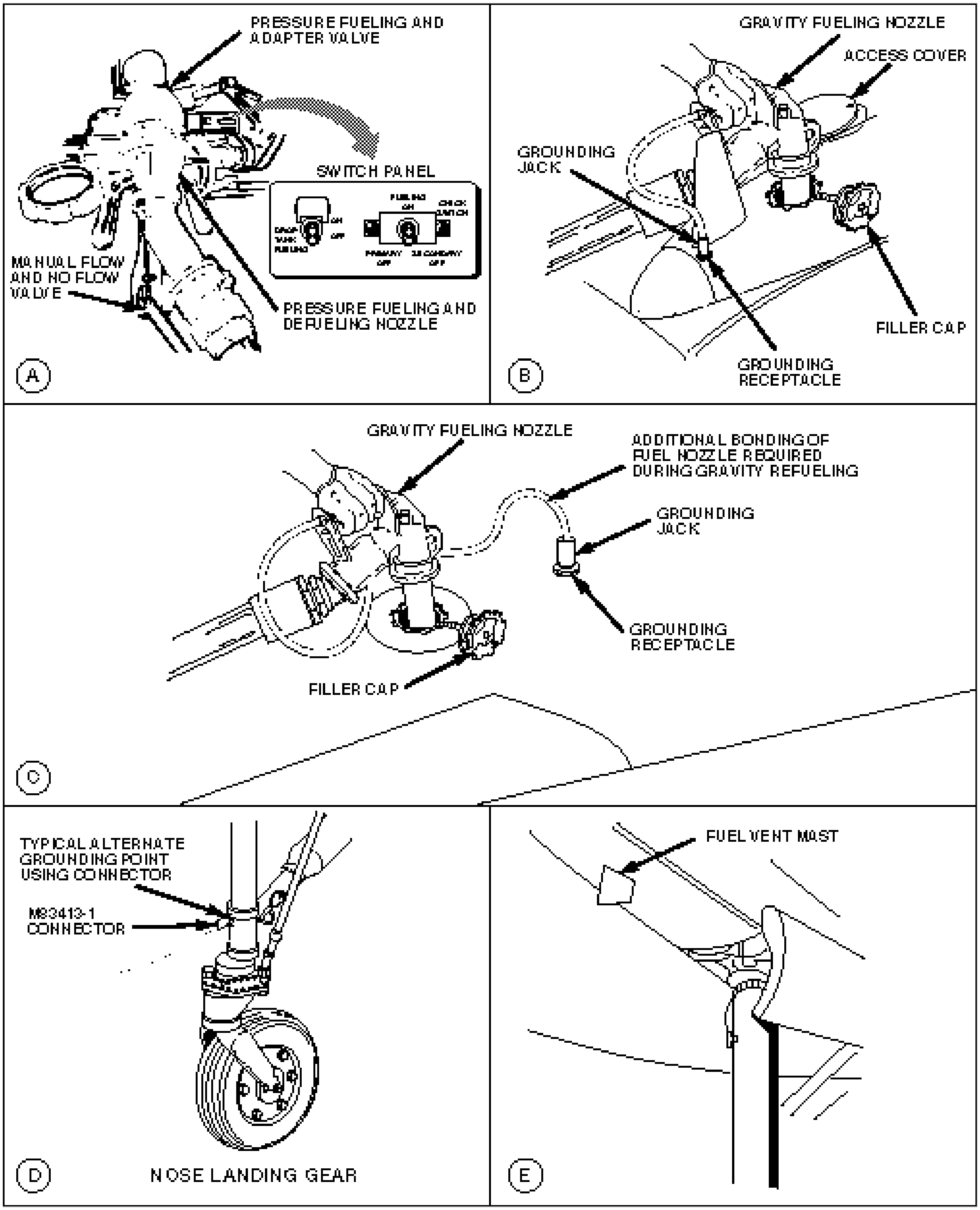
**WARNING**

Tie down chains cannot be used to ground aircraft.



# APPENDIX C

# AIRCRAFT: TA-4



# APPENDIX C

# AIRCRAFT: TA-4

## TABLE OF FUEL CAPACITIES

| Tank | | Gallons |
|---|---|---|
| Internal | Fuselage | 104 |
| | Wing | 560 |
| External | AERO 1C | 147 |
| | AERO 1D | 295 |
| | ATP-D1B | 396 |
| | Air Refueling Store | 295 |

## AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Wing Span | 27 ft 6 in | Maximum Gross Weight — 24,500 lbs |
| Length | 43 ft 7 in | Maximum Footprint — 350 psi |
| Height | 15 ft 7 in | |

## A-4 REFUELING PROCEDURES

The following procedures cover only those refueling procedures that are unique to the A-4 aircraft, primarily the operation of the "pre-check" system.

### PRE-CHECK PROCEDURES

1. Prepare aircraft and refueling system in accordance with the applicable procedure in Chapter 6, 12, or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109.

2. Ensure that CHECK SWITCH on fueling panel is in FUELING ON position.

3. Connect external ac power to aircraft. (Refer to External Power Application.)

**WARNING**

Proper connection of ac external power cable plug to aircraft external power receptacle should be made. Failure to insert plug completely into receptacle can result in presence of high voltage on aircraft metal surfaces.

4. Place external ac power switch in EXTERNAL position.

5. Start pressure fueling equipment and open manual flow and no-flow valve on pressure fueling nozzle.

6. Immediately after pressure fueling has started, test the fuel vent system for proper functioning by holding the hand beneath fuel vent mast.

**WARNING**

If air is not exhausting from fuel vent mast, stop pressure fueling immediately and investigate the fuel vent system. Failure to comply may result in damage to equipment and injury to personnel.

7. During the initial stage of pressure fueling, perform functional test of pressure fueling shutoff components in sequential order as shown in steps 8 through 12.

8. Place and hold CHECK SWITCH in PRIMARY OFF position. Fuel flow will stop in 1 to 3 seconds.

**CAUTION**

If fuel flow does not stop in 1 to 3 seconds, stop fueling immediately and investigate cause.

## APPENDIX C

## AIRCRAFT: TA-4

**Note**

Because of fuel flow through pilot lines of float valves, a 2-gpm maximum flow (registered on pressure fuel meter) is permissible.

9. Return CHECK SWITCH to FUELING ON position. Fuel flow should start.

10. Place CHECK SWITCH in SECONDARY OFF position. Fuel flow will stop in 1 to 3 seconds.

11. Return CHECK SWITCH to FUELING ON position. Fuel flow should start.

12. Upon satisfactory completion of functional test, continue pressure fueling of aircraft.

13. During pressure fueling, inspect for evidence of fuel leakage. Correct if required.

If partial aircraft internal fuel load with full external tanks is desired, proceed as follows, disregarding steps 21, 22, and 23:

14. Place and hold CHECK SWITCH in the PRIMARY or SECONDARY OFF position, and place DROP TANK FUELING switch in the ON position. Fuel flow should start into external tanks only.

15. When fuel flow stops, return CHECK SWITCH to the FUELING ON position and return DROP TANK FUELING switch to the OFF position.

**CAUTION**

If fuel flow does not shut off and overflows from an external fuel tank, stop fueling immediately and investigate the cause.

16. When internal quantity reaches desired amount, close manual flow and no-flow valve and shutdown pressure fueling equipment.

**CAUTION**

If a full fuel load is desired, disregard steps 14, 15, and 16, and proceed as follows.

# APPENDIX C

# AIRCRAFT: TA-4

17. Place DROP TANK FUELING switch in the ON position. Fuel flow should commence to the external tanks.

18. After fuel flow has stopped (cell and tanks full), check fuel-delivered meter for indication of pressure fueling system internal leakage. Maximum leakage must not exceed 1 gpm.

19. Close manual flow and no-flow valve, and shut down pressure fueling equipment.

20. Place external ac power switch in INTERNAL position.

21. Disconnect external ac power from aircraft.

22. Disconnect pressure fueling nozzle from pressure fueling/defueling adapter valve and install cap.

23. Place DROP TANK FUELING switch in OFF position.

24. Close and secure aft fuselage lower access door, if applicable.

25. Replace external fuel tank caps, if removed.

## HOT REFUELING

The A-4 aircraft can be hot refueled only (engine running) through the aerial refueling probe because of the location of the pressure refueling adapter. The aircraft and shore-based refueling system should be prepared in accordance with paragraph 12.9 of Chapter 12 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109.

The following procedures should be strictly followed by pilots and ground personnel when refueling aircraft with the engine running.

**Note**

A-4 aircraft will be hot refueled through the probe only.

## PRIOR TO REFUELING

1. The aircraft will be chocked.
2. The plane captain should attach grounding wire to aircraft before any other connections are made.
3. The pilot will close and lock the canopy and select RAM air. The radio will be set on ground control or, if aboard ship, other appropriate frequency.
4. Drop tank pressurization switch should be placed in OFF position.
5. Ensure that FUEL TRANSFER BYPASS switch (A-4 AFC-317) is in the OFF position.

# APPENDIX C

# AIRCRAFT: TA-4

**CAUTION**

Ensure that fuel dump switch is in OFF position prior to refueling.

6. The work stand should be positioned in front of inflight refueling probe and wheels should be locked.

7. The nozzle operator should attach nozzle adapter to the probe.

8. The pilot should signal to fuel pit coordinator when he is ready for commencement of fueling by thumbs-up signal in daytime, and by thumbs-up illuminated by flashlight at night.

**AFTER COMMENCEMENT OF HOT REFUELING**

The plane captain should visually check drop tanks upon completion of hot refueling to ensure that tanks are either completely full or completely empty. This procedure applies whether the drop tank fueling switch has been placed in the ON or OFF position during refueling. In all hot refueling operations the pilot should check his external fuel gauge to ensure the proper fuel load after completion of refueling.

1. Nozzle operator should slowly open valve and check for fuel leaks until the valve is fully open.

2. Immediately upon commencement of fueling, the plane captain should conduct the primary and secondary valve checks in accordance with the Maintenance Instruction Manual, NAVAIR 0140AVD-2-4.l. If this check is not satisfactory, the refueling operation should be secured immediately.

3. If the drop tanks are to be filled, the plane captain should either place the DROP TANK FUELING switch in the ON position, or the pilot should place the DROP TANK pressurization switch to the FLIGHT REFUEL position.

**Note**

When refueling ashore, gravity fueling methods should be used for partial drop tank loads.

4. Appropriately assigned personnel should monitor vent mast on wing to ensure that it is not obstructed.

**WARNING**

If pressure cannot be felt coming from the vent mast, the refueling operation should be secured immediately.

# APPENDIX C

# AIRCRAFT: TA-4

5. The pilot should signal the pit coordinator by a cut signal in the daytime and by flashlight at night when refueling is completed. The pit coordinator should signal the nozzle operator and pit operator. The nozzle operator should close the valve on the nozzle but should not remove the probe adapter until the pit operator has evacuated all fuel from the hose.

**Note**

The rotating beacon should be used as an emergency fuel cutoff signal at night.

6. The ground wire should be detached after all other refueling equipment is removed.
7. A qualified lane director should direct the aircraft out of the pits.

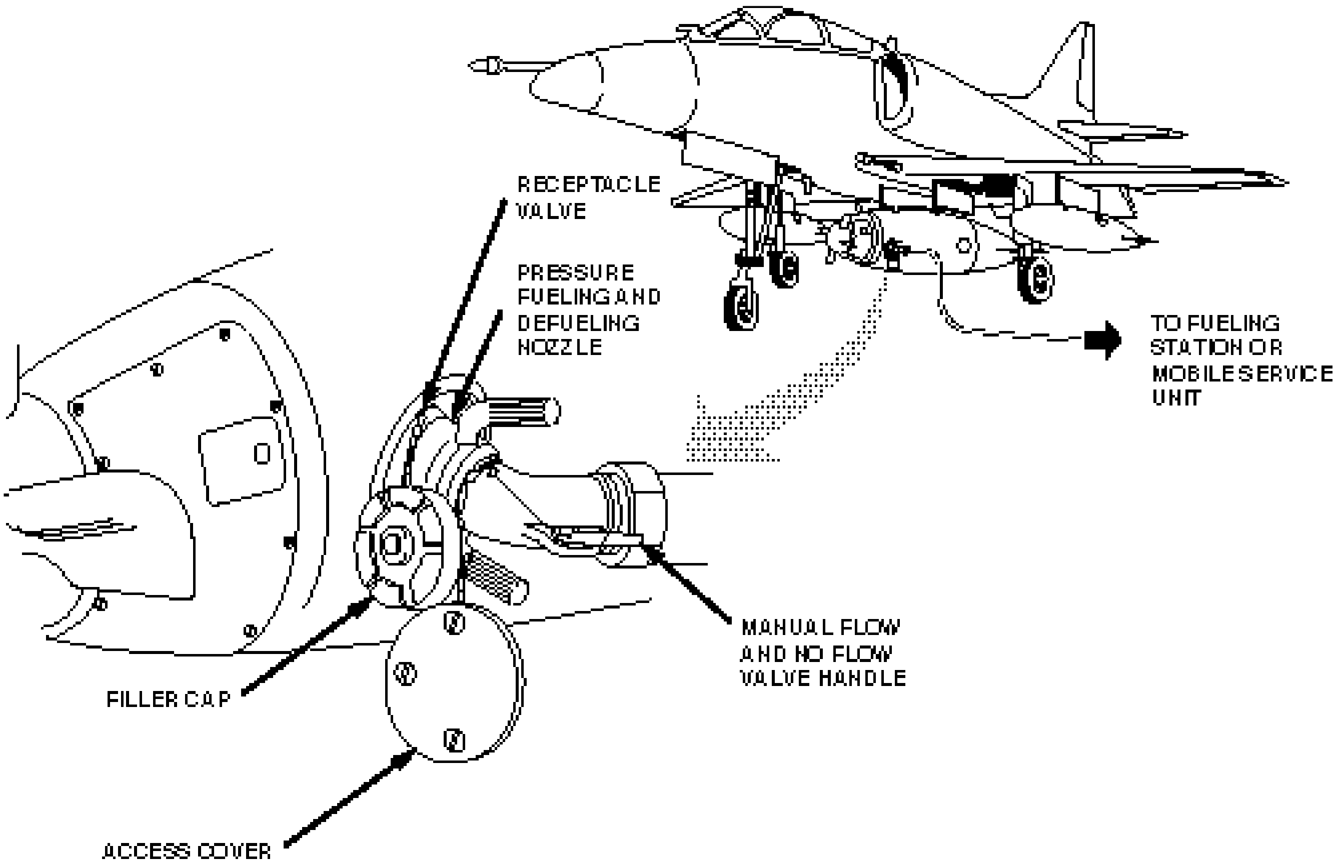
**SPECIAL NOTES — AIRCRAFT FUEL SYSTEM**

1. The fuel grade selector on the engine fuel control should correspond to the grade of fuel being used. After JP-4 is introduced into the fuel system of the engine, the specific gravity switch on the fuel control should be set to JP-4. The setting should not be returned to JP-5 until after the first flight during which JP-5 has been used. When using a combined fuel load of JP-4 and JP-5 on the JP-4 setting, the pilot should monitor EGT to ensure that full throttle operation remains within the prescribed limits. Use the JP-5 setting on the control when using JP-8 fuel.

# APPENDIX C

## AIRCRAFT: TA-4

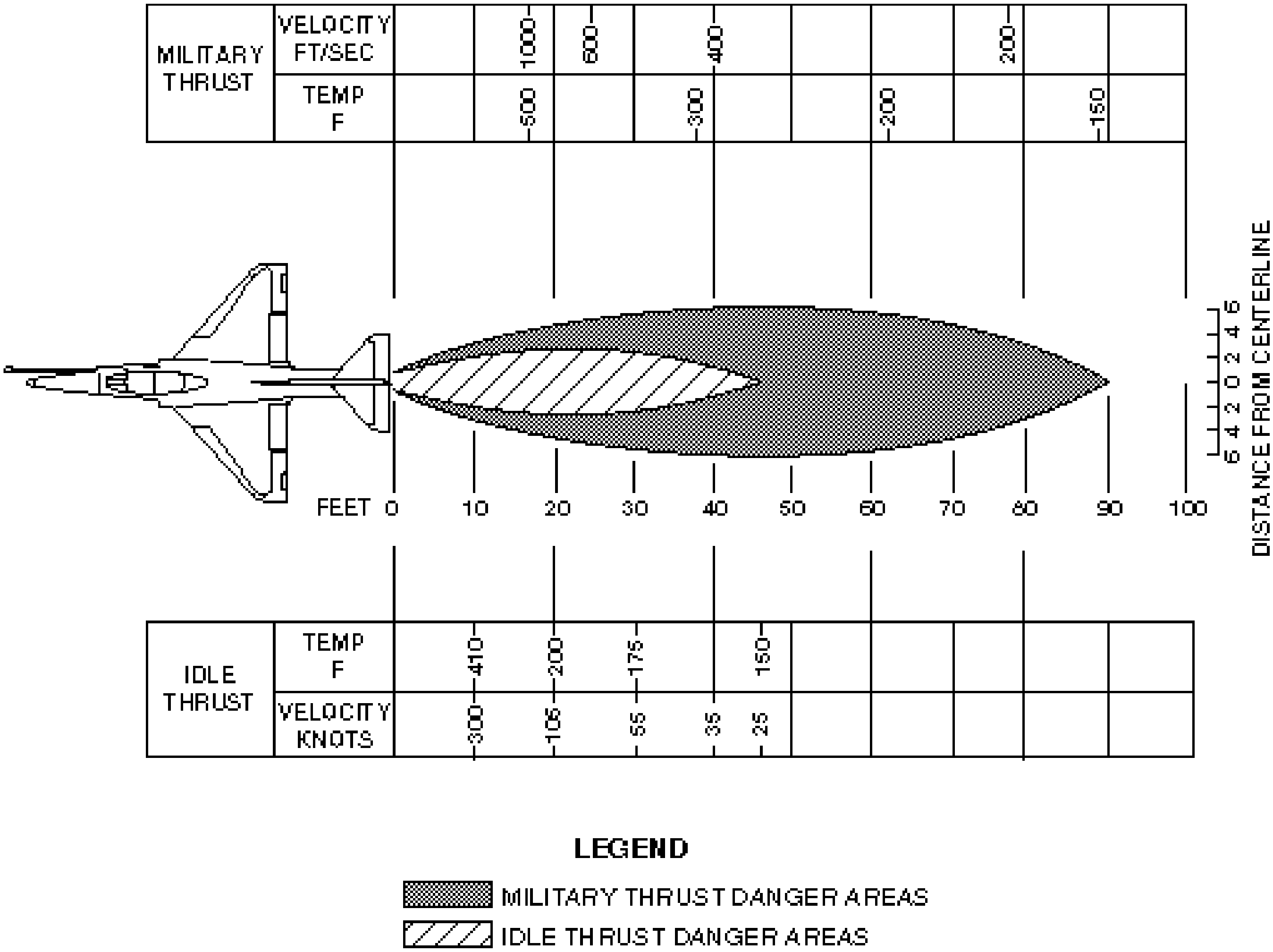
## EXTERNAL TANK REFUELING



## APPENDIX C

## AIRCRAFT: TA-4

## PERSONNEL DANGER ZONES




**CAUTION**

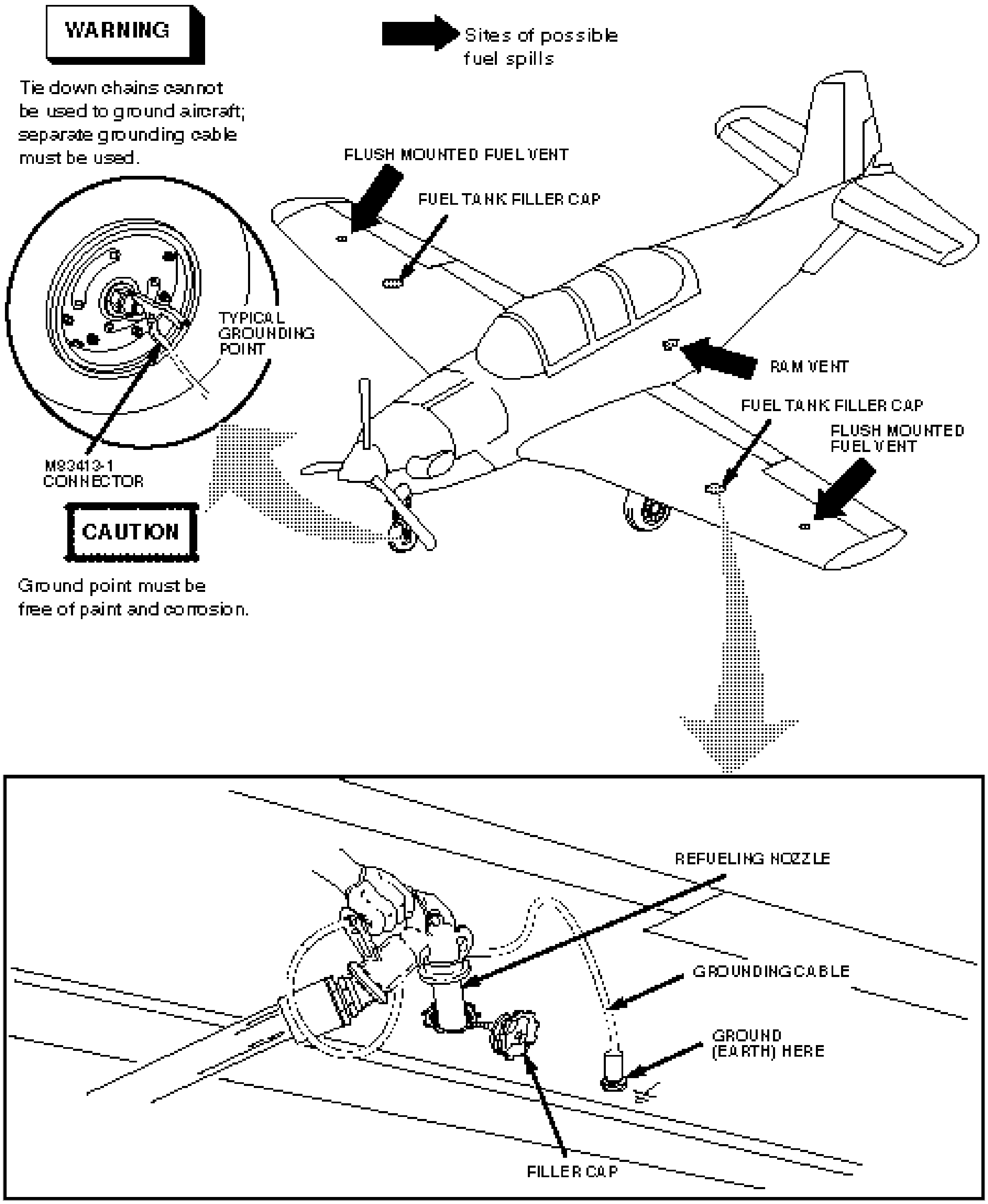
- Approach aircraft from side, but not in line with turbine disintegration pattern.
- Stay clear of engine air inlet, exhaust, and gun and rocket patterns.
- Avoid wearing loose clothing or carrying loose articles near engine air inlet.

Do not foolishly experiment with safety margins noted.

# APPENDIX C

## AIRCRAFT: T-34

### AIRCRAFT CONFIGURATION



# APPENDIX C

# AIRCRAFT: T-34

## TABLE OF FUEL CAPACITIES

| Tank | Gallons |
|---|---|
| Wing Leading Edge | 40 Each |
| Wing Panel | 25 Each |
| Total | 130 |

## AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Wing Span | 33 ft 5 in | Maximum Gross Weight — 4,425 lbs |
| Length | 28 ft 8 in | Maximum Footprint — 90 psi |
| Height | 9 ft 11 in | |

## T-34 REFUELING PROCEDURES

The T-34 aircraft does not have a single-point refueling adapter and, therefore, can only be gravity refueled.

**GRAVITY FUELING**

1. Attach bonding cables to aircraft.
2. Attach bonding cable from hose nozzle to ground socket adjacent to fuel tank being filled.
3. Open applicable fuel tank filler cap.

**CAUTION**

Do not insert fuel nozzle completely into fuel tank because of possible damage to bottom of fuel cell.

4. Fill fuel tank with fuel.
5. Secure applicable fuel tank filler cap.

**CAUTION**

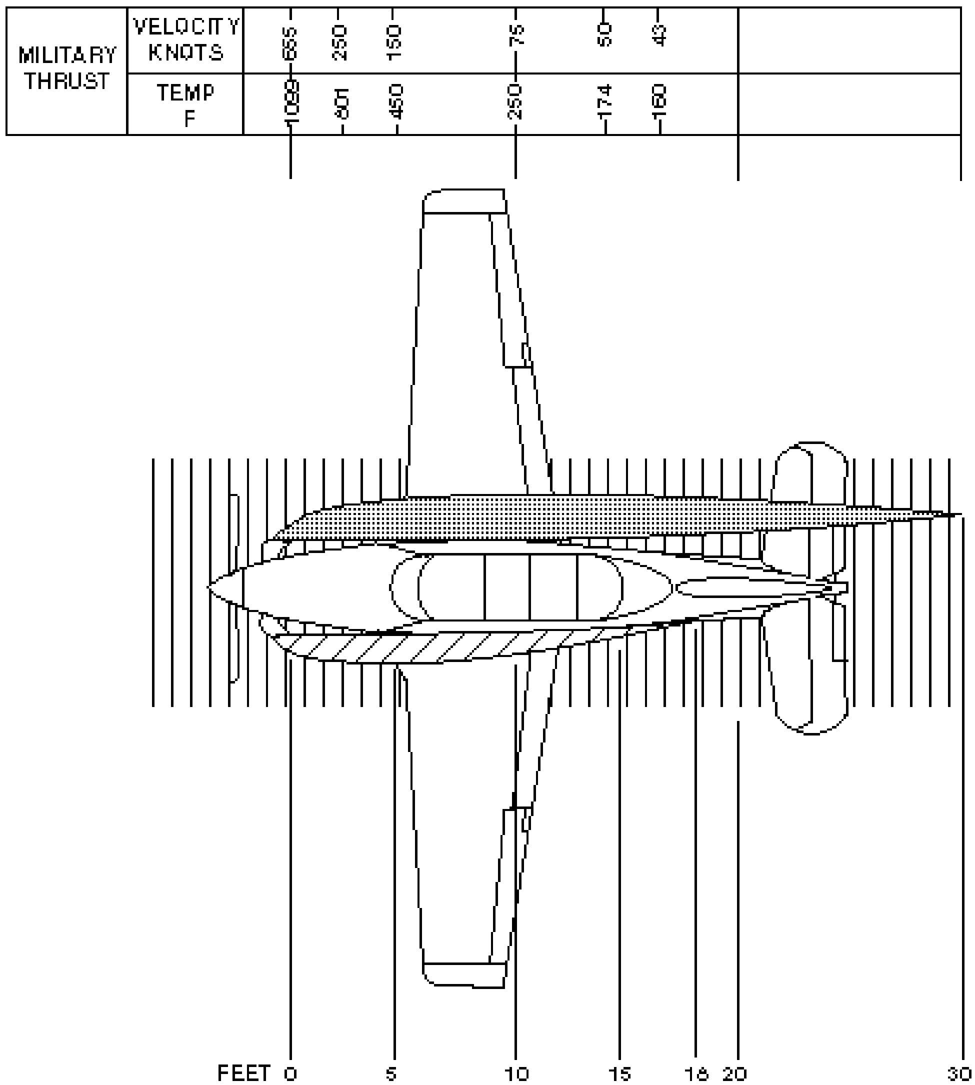
Make sure latch tab on cap is pointed aft.

6. Disconnect bonding cables from aircraft.

# APPENDIX C

## AIRCRAFT: T-34

### PERSONNEL DANGER AREAS




**LEGEND**

EXHAUST DANGER AREAS (GROUND IDLE)

EXHAUST DANGER AREAS (MAX POWER)

PROPELLER DANGER AREA

**NOTE**

- The exhaust danger area does not include propeller wake, which increases velocity and significantly reduces temperature.

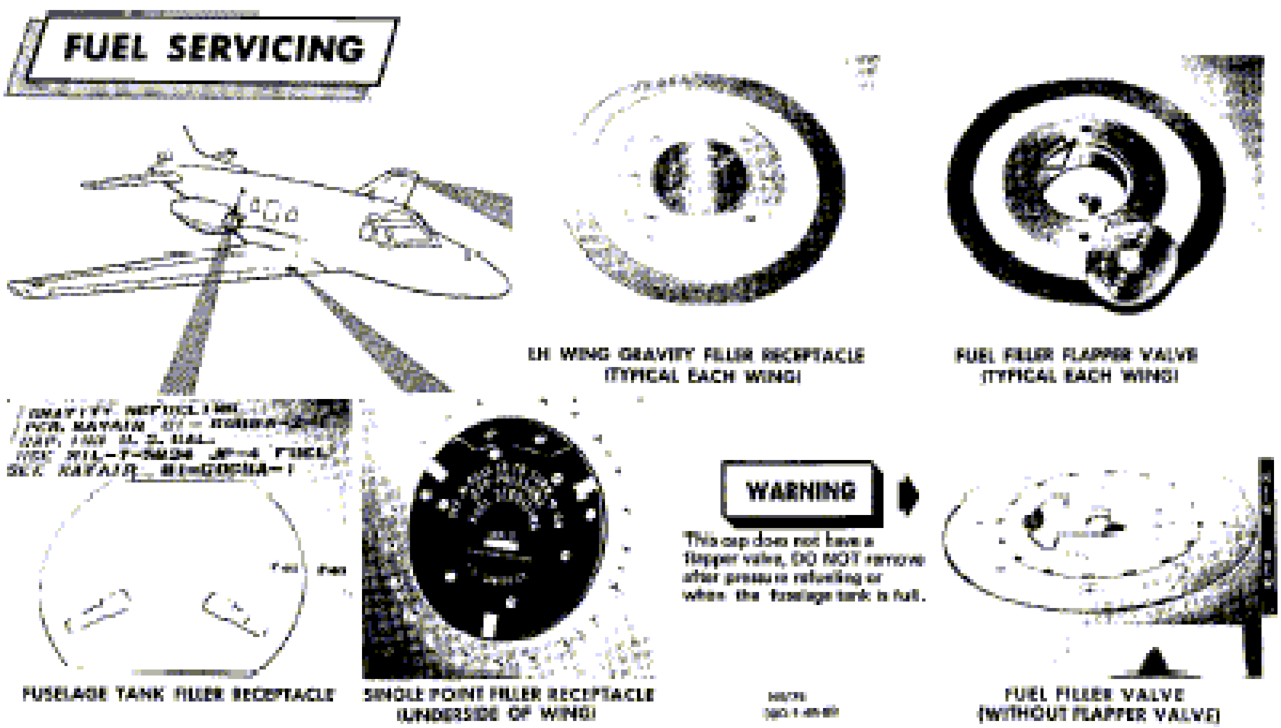
- Exhaust gas temperature and velocity at ground idle are very low; however, the immediate area of exhaust discharge should be avoided.

# APPENDIX C

# AIRCRAFT: T-39

**(The following diagrams have been extracted from the T-39D NATOPS manual and are the best reproductions available.)**

## REFUELING PROCEDURES



# APPENDIX C

# AIRCRAFT: T-39

## SINGLE-POINT REFUELING


1. Remove pressure refueling cap.

2. Insert nozzle grounding plug into jack on aircraft.

**CAUTION**

- Check to be sure that the single-point refueling receptacle is completely engaged prior to refueling. If it is not, damage may be done to the refueling receptacle.
- Before start of refueling, ensure that refueling hose is free from kinks.

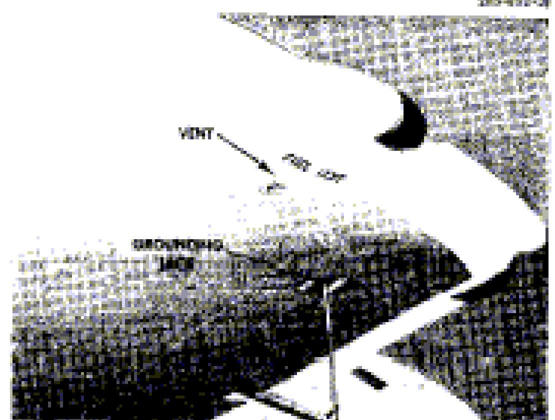
3. Connect and lock refueling nozzle. Start ground servicing unit. Refueling pressure should be 45-55 psi

4. Depress **PRI TEST** button. Fueling should stop (hose will stiffen).

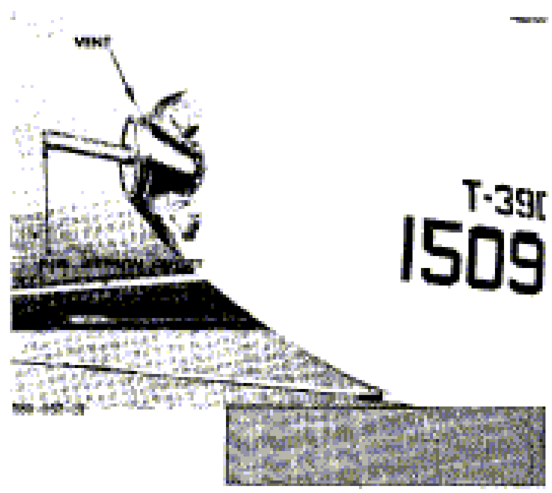
5. Depress **SEC TEST** button. Fueling will stop (hose will stiffen).

6. Depress **FILL AUX** and **SHUTOFF AUX** buttons together. Release **SHUTOFF AUX** button first; **FILL AUX** button should remain in depressed position. Full servicing should be completed in approximately 12 minutes.

7. Check wing fuel tank vents at both wing tips for obstructions and passage of air to ensure proper wing tank venting. If no passage of air is noted, secure the fueling operation and have discrepancy investigated.




8. Fuel may come out wing tip vents. If this occurs, turn off refueler momentarily. Valves will reseat.



# APPENDIX C

tank. (See figure 1-56.) The single-point refueling system is shown in figure 1-58.

SINGLE-POINT REFUELING TEST AND FUSELAGE TANK REFUELING CONTROL BUTTONS. The single-point refueling test and fuselage tank refueling control buttons (figure 1-58) are flush-mounted in the undersurface of the right wing leading edge, adjacent to the single-point refueling receptacle. Two buttons, PRI TEST and SEC TEST, govern primary and secondary refueling valve test procedures for all tanks.

**NOTE** Single-point refueling can be accomplished without turning on any electrical power.

Satisfactory valve operation is indicated by the shutoff of fuel flow, accompanied by the stopping of vibration and the stiffening of the refueling hose. A more positive indication of fuel shutoff can be obtained by observing the counter on the ground refueling equipment. An FILL AUX button controls flow to the fuselage tank. A SHUTOFF AUX button locks and holds the FILL AUX button during fuselage tank refueling. To lock the FILL AUX button, depress both the FILL AUX and SHUTOFF AUX buttons, and then release the SHUTOFF AUX button; the FILL AUX button will remain depressed.

**NOTE** When refueling operations are completed, the FILL AUX button sometimes remains depressed. If this happens, there is no cause for concern.

- The fuel quantity gages should be checked to ensure proper wing fuel balance and quantity.

GRAVITY REFUELING. Gravity refueling of the aircraft is possible by filling through the fuselage tank filler while manually holding the spring-loaded fuel filler flapper on each wing tip open. (See figure 1-55.) The flappers must be released just before the fuel overflows from the opening. Then continue filling the fuselage tank until full. By using this method of refueling, it will take a minimum of 30 minutes to refuel the aircraft.

**NOTE** Observe all refueling precautions, as some fuel may be spilled before the fuel filler flappers are released.

- Total usable fuel after gravity refueling will be about 8 US gallons (52 pounds) less than after pressure refueling.

ENGINE OIL SERVICING.

The engine oil level must be checked and serviced within one hour after engine shutdown.

**NOTE** When an accurate reading of the oil tank level is needed, following engine shutdown, the engine should be operated at approximately 75 percent rpm for not less than 15 nor more than 30 seconds, immediately before shutdown, in order to scavenge oil properly from inside the engine.

1. Open oil tank filler access door F47, on left engine pod, or F48, on right engine pod.
2. Remove oil tank filler cap by raising locking tab and rotating tab counterclockwise until filler cap is released; then remove cap. (See figure 1-59.)
3. Check that oil level is at normal operating level.

**NOTE** One of three possible dip sticks may be used. See figure 1-59 for normal operating level of dip stick installed.

4. When oil is low, add lubricating oil to obtain proper oil level, as indicated in step 3.
5. Insert dip stick and install oil tank filler cap by placing cap in position and rotating locking tab clockwise to lock cap; then press tab down into stowed position.

**NOTE** Before closing oil tank filler access door, check for proper installation and security of filler cap. If the cap is properly installed, it will be flush with the edges of the recess in the oil tank.

6. Close engine oil tank filler access door.

HYDRAULIC SERVICING.

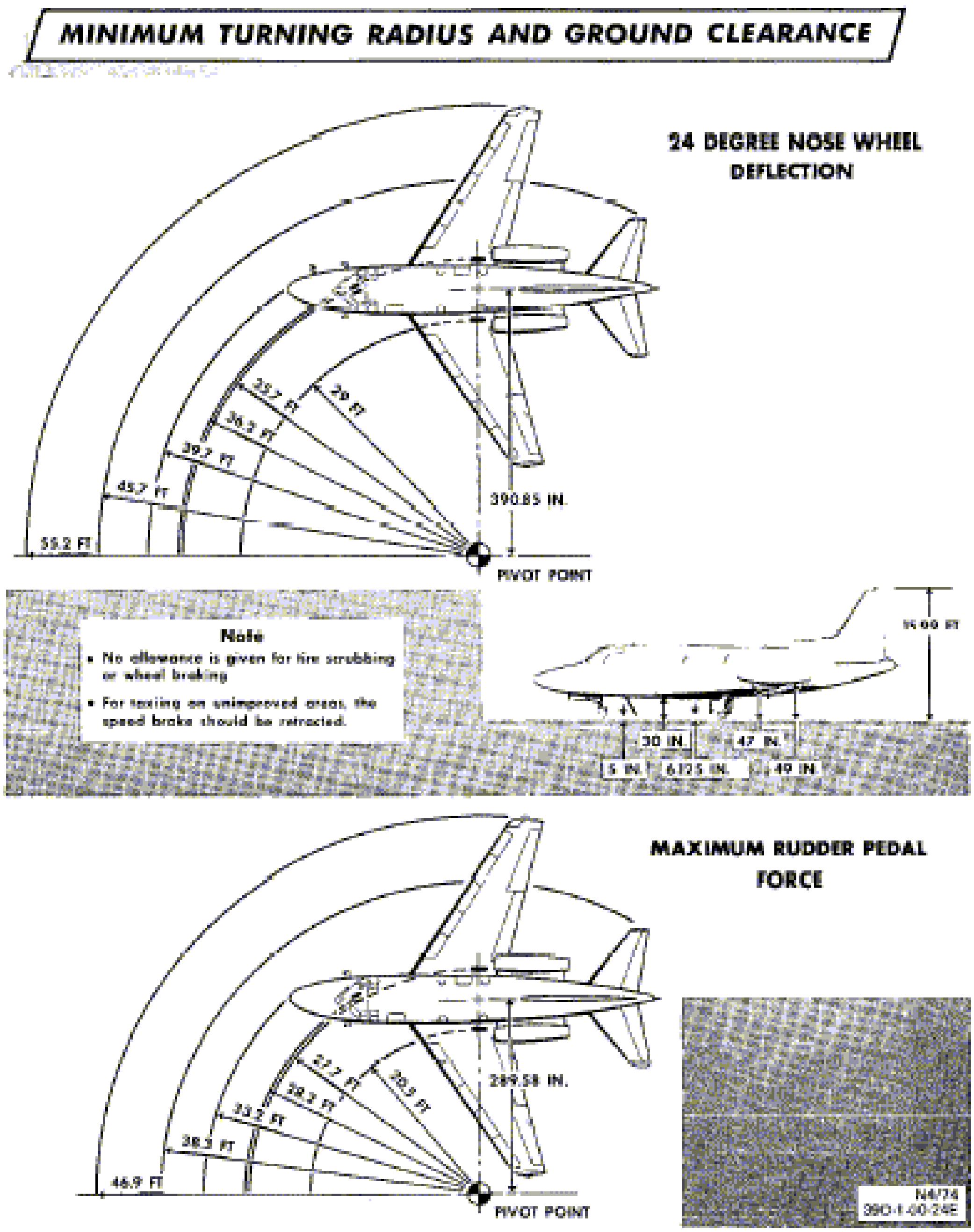
FILLING HYDRAULIC RESERVOIR. The hydraulic system is filled through the fluid reservoir. (See figure 1-60.) The hydraulic power system, including all of the subsystem components, holds about 5 US gallons. The reservoir contains 2.6 US gallons when serviced to the "FULL" mark. Fill reservoir as follows:

1. Check that landing gear is down and locked, and that speed brake is closed.

# APPENDIX C

# AIRCRAFT: T-39

## DANGER AREAS



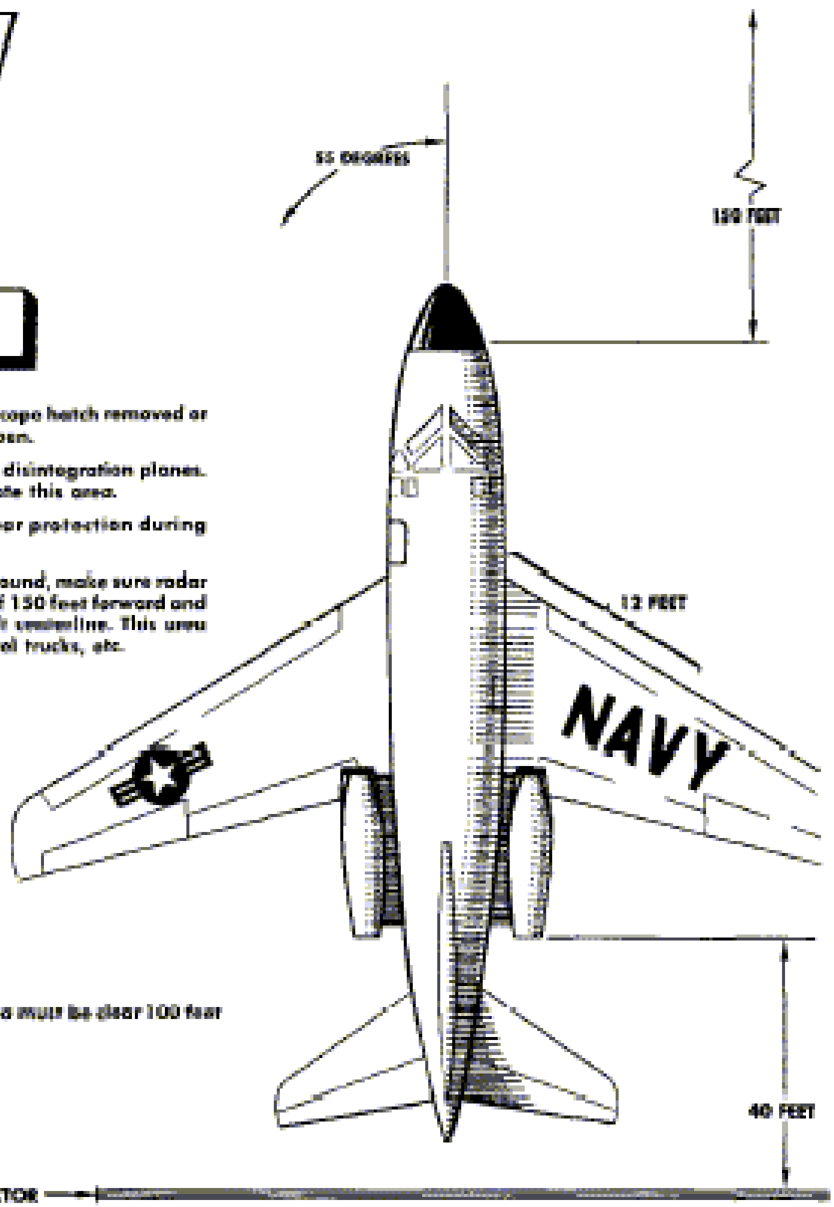
# APPENDIX C

# AIRCRAFT: T-39

## DANGER AREAS

### WARNING

- Do not operate right engine with escape hatch removed or left engine above idle with door open.
- Keep clear of engine turbine wheel disintegration planes. Red stripes on engine pods designate this area.
- Ground personnel should wear ear protection during ground operation.
- Before operating the radar on the ground, make sure radar beam will be clear for a minimum of 150 feet forward and 35 degrees right and left of aircraft centerline. This area must be kept clear of personnel, fuel trucks, etc.




**Note**

If blast deflector is not available, area must be clear 100 feet aft of aircraft.

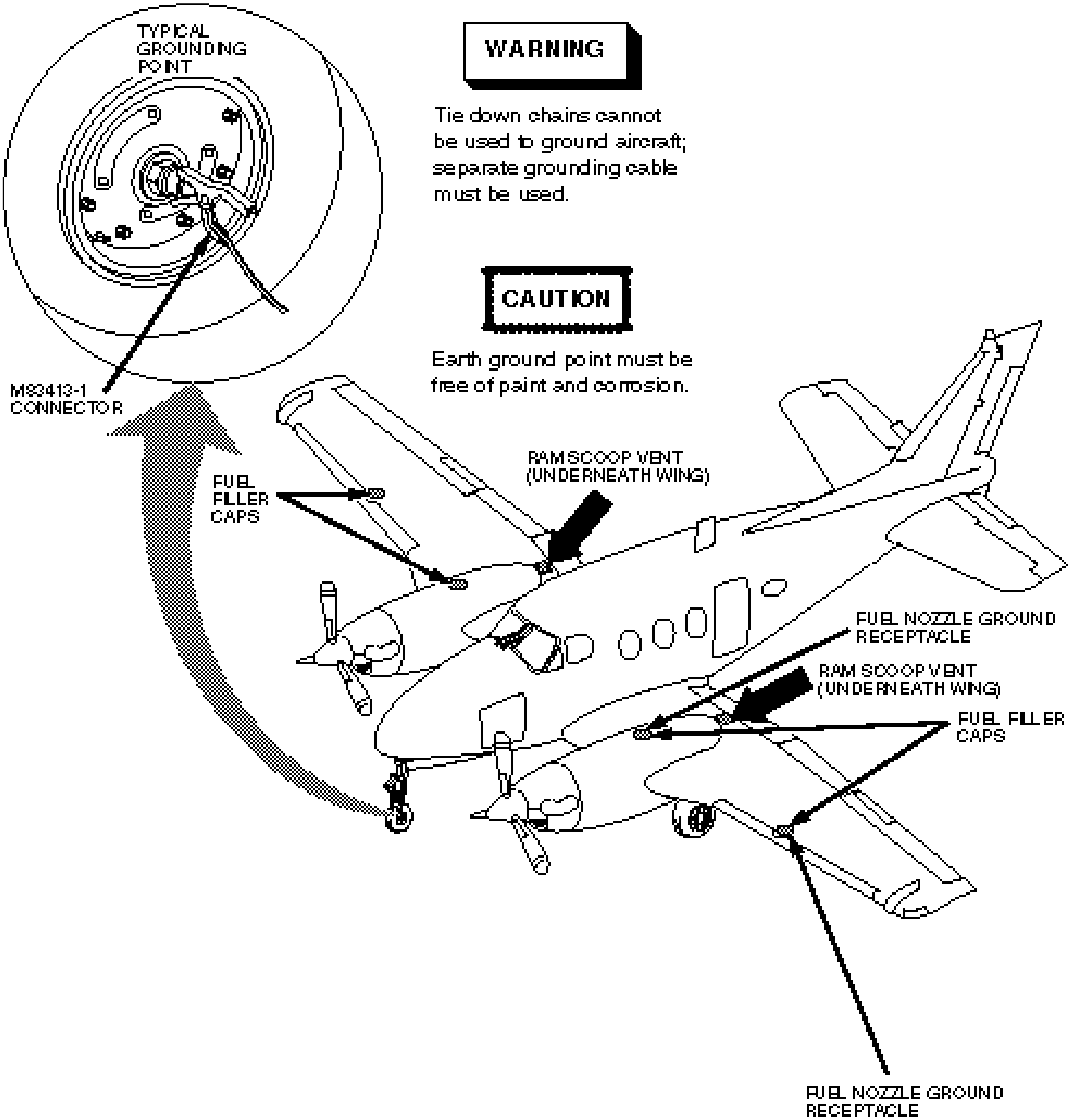
| DISTANCE AFT OF TAIL PIPE—FEET | 5 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 |
|---|---|---|---|---|---|---|---|---|---|
| VELOCITY—MPH | 1365 | 785 | 505 | 435 | 320 | 265 | 190 | 150 | 115 |
| | 305 | 170 | 120 | 95 | 70 | 60 | 35 | | |
| TEMPERATURE | 650°C (1200°F) | 343°C (650°F) | 232°C (450°F) | 182°C (360°F) | 143°C (290°F) | 127°C (260°F) | 99°C (210°F) | 80°C (175°F) | 52°C (125°F) |
| | 315°C (600°F) | 243°C (470°F) | 170°C (340°F) | 132°C (270°F) | 107°C (225°F) | 85°C (185°F) | 65°C (150°F) | | |

Military Thrust in BLACK figures.
Idle thrust in WHITE figures.

# APPENDIX C

## AIRCRAFT: T-44

### AIRCRAFT CONFIGURATION



# APPENDIX C

# AIRCRAFT: T-44

## TABLE OF FUEL CAPACITIES

| Tank | Gallons |
|---|---|
| Nacelle | 61 Each |
| Wing Tanks | 132 Each |
| Total Useable | 384 |
| Total Capacity | 387.6 |

## AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Wing Span | 50 ft 2.9 in | Maximum Gross Weight — 9,710 lbs |
| Length | 35 ft 6 in | Maximum Footprint — 57 psi |
| Height | 14 ft 2.6 in | |

## T-44 REFUELING PROCEDURES

The T-44 aircraft can only be gravity refueled.

### GRAVITY FUELING

1. Attach bonding cables to aircraft.
2. Attach bonding cable from hose nozzle to ground.
3. Open applicable fuel tank filler cap.

**WARNING**

Do not insert fuel nozzle completely into fuel cell because of possible damage to bottom of fuel cell.

4. Fill fuel tank with fuel using slow fuel discharge rate.
5. Secure applicable fuel tank filler cap.

**CAUTION**

Ensure latch tab on cap is pointed aft.

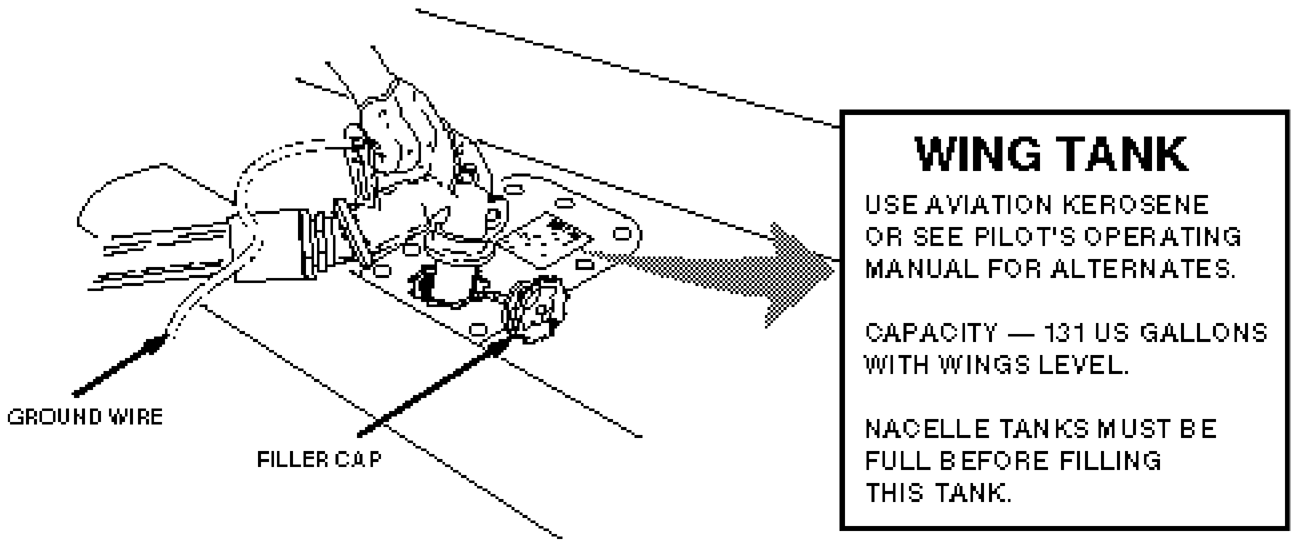
6. Disconnect bonding cables from aircraft.

## APPENDIX C

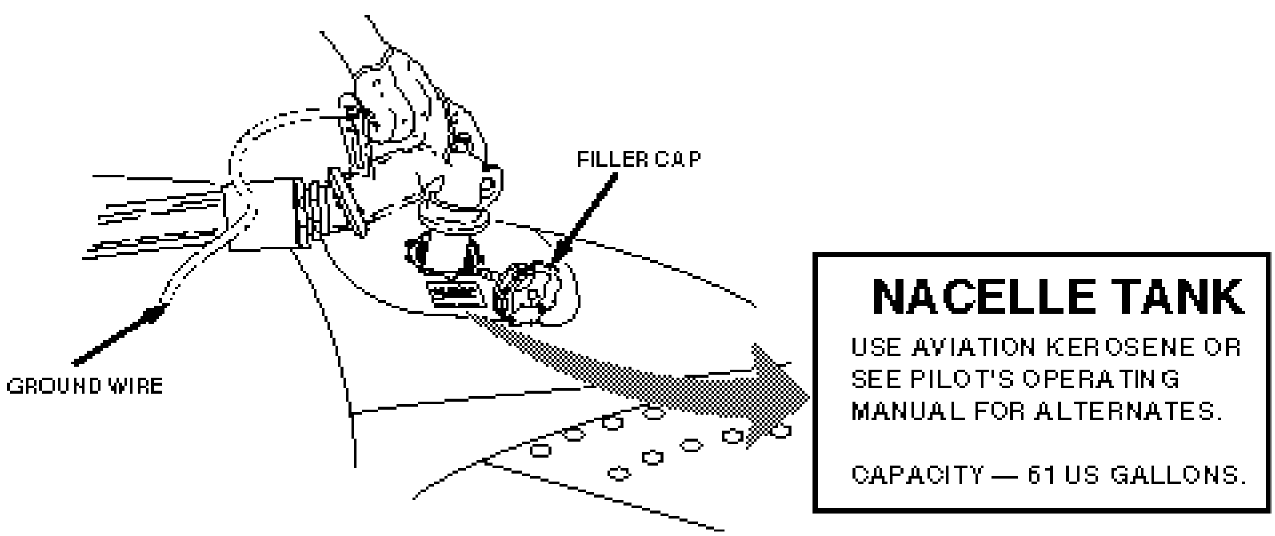
## AIRCRAFT: T-44

### GRAVITY FILL PORTS

WING TANK GRAVITY FILLER




NACELLE FUEL CELL GRAVITY FILLER

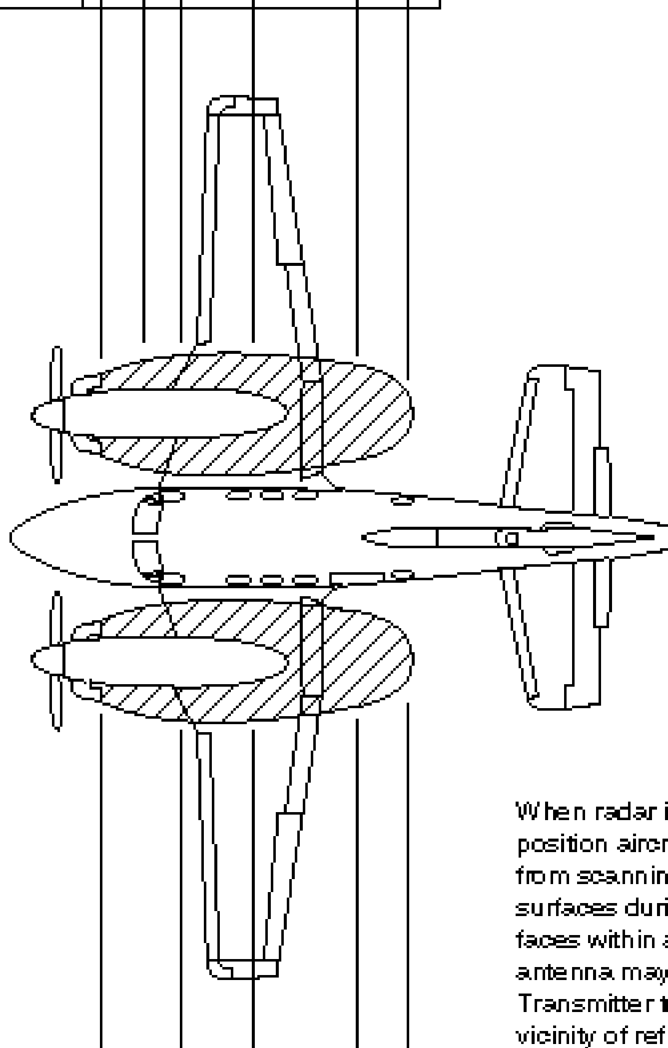


# APPENDIX C

# AIRCRAFT: T-44

## PERSONNEL DANGER ZONES

| GROUND IDLE (UNFEATHERED) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | VELOCITY KNOTS | 12 | 20 | 80 | | 70 | 50 |
| | TEMP F | 79 | 79 | 155 | 105 | 110 | 135 |



| GROUND IDLE (FEATHERED) | | | | | | |
|---|---|---|---|---|---|---|
| | VELOCITY KNOTS | 12 | 20 | | 10 | 5 |
| | TEMP F | 79 | 155 | 87 | 82 | 81 |

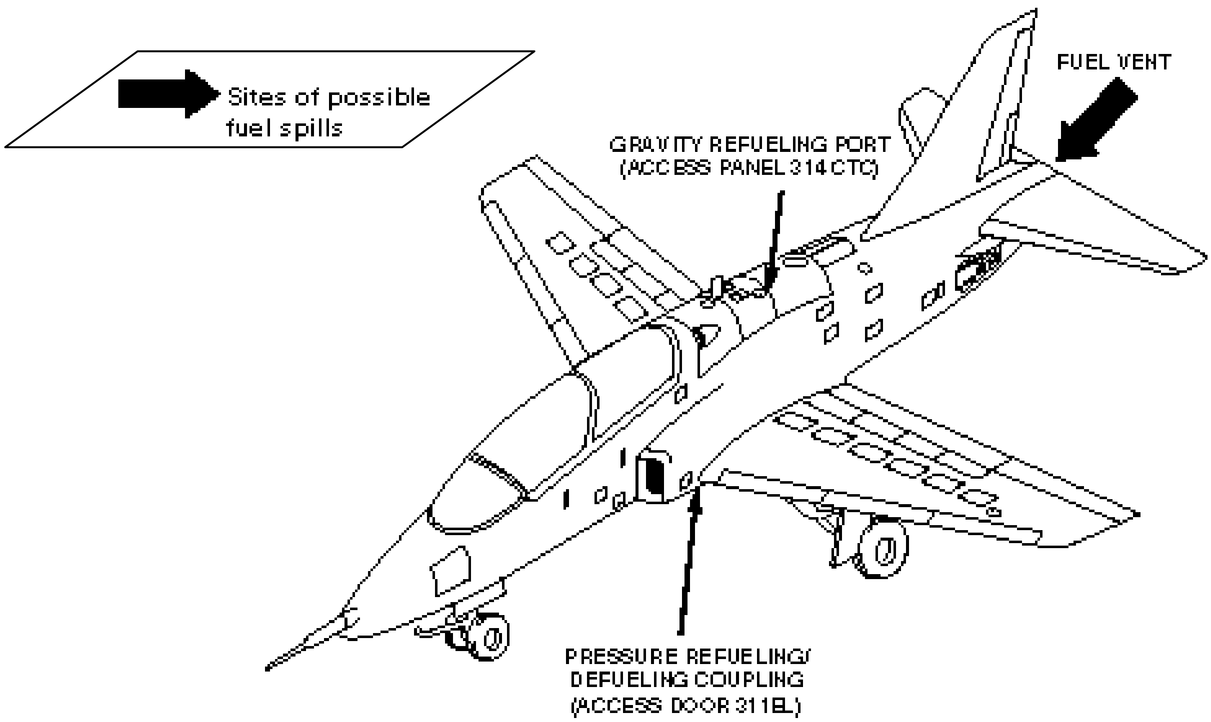
**CAUTION**

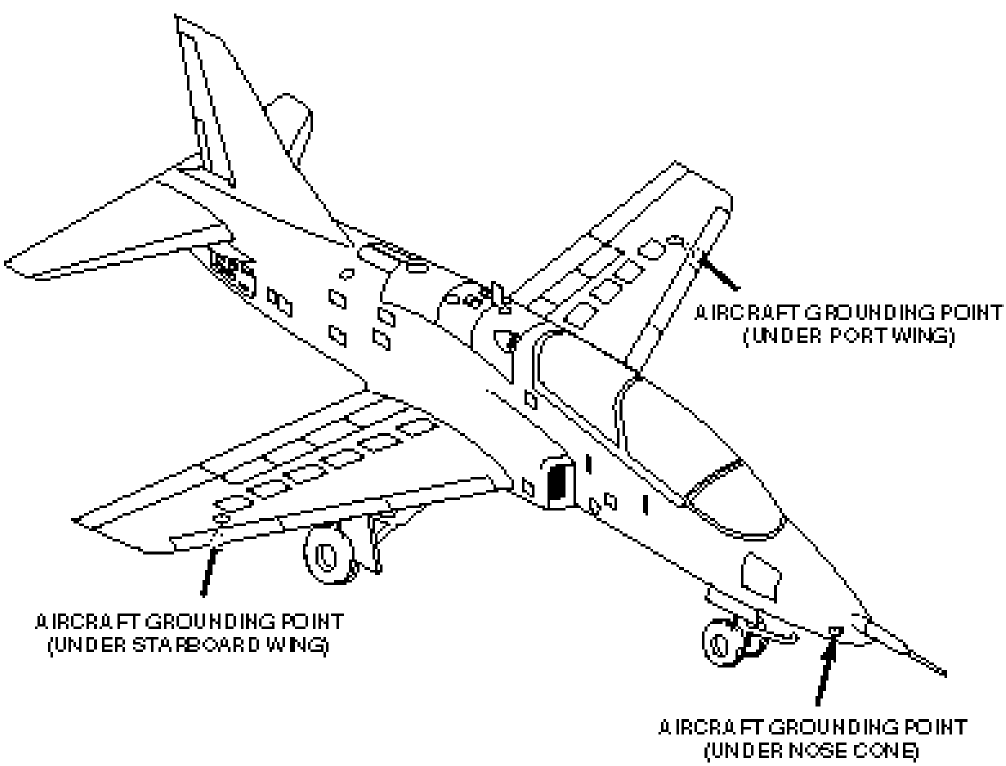
When radar is operating into antenna, position aircraft to prevent the antenna from scanning any large, close-by metallic surfaces during test. Scanning such surfaces within approximately 50 feet of the antenna may damage receiver crystals. Transmitter tests must not be made in the vicinity of refueling operations, or when personnel are standing within 18 feet of area being scanned. RF energy is generated in all modes except Standby and Test. It is not necessary to place aircraft in a level flight attitude.

# APPENDIX C

## AIRCRAFT: T-45

### AIRCRAFT CONFIGURATION



# APPENDIX C

# AIRCRAFT: T-45

## TABLE OF FUEL CAPACITIES

| Tank | Gallons |
|---|---|
| Integral Wing and Fuselage | 432 |
| Useable | 432 |
| Total Capacity | 443 |

## AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Wing Span | 30 ft 10 in | Maximum Gross Weight — 14,500 lbs |
| Length | 39 ft 4 in | Maximum Footprint — 145 psi |
| Height | 13 ft 6 in | |

## T-45 REFUELING PROCEDURES

The following procedures cover only the refueling procedures that are unique to the T-45 aircraft, primarily the operation of the “pre-check” system.

1. Prepare aircraft and refueling system in accordance with the applicable procedure in Chapter 6, 12, or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109.

2. Connect refueling nozzle.

**PRE-CHECK PROCEDURE**

**Note**

Aircraft cannot be pressure fueled without electrical power available. If aircraft electrical power is not available, external power can be used.

1. Ensure REFUEL/DEFUEL switch is set to REFUEL.

2. Verify that INLET FUEL DISABLE indicator light and INLET VALVES L and R indicator lights are illuminated.

**WARNING**

If lights do not illuminate, discontinue refueling procedure; one or both transfer valves may be open resulting in a fuel spill.

3. Place tanker control in REFUEL position and start to pump fuel.

4. Press and hold PRECHECK switch and verify the following:

    a. FSLG VALVE light will illuminate within 15 seconds.

    b. Fuel flow will reduce to less than 5 GPM.

    c. Release PRECHECK switch.

    d. FSLG VALVE light extinguishes and fuel flow returns to normal.

5. Verify that air is being exhausted from fuel vent on the tail cone. If fuel is discharged, discontinue refueling immediately.

6. Continue refueling until fuel flow automatically stops.

7. Verify FSLG VALVE light is illuminated.

**Note**

The FSLG VALVE light will extinguish when refueling pressure is removed from the aircraft.

Since Aircraft 163600 through 163646 are not equipped with a "pre-check" system, the following special procedures for Hot Refueling apply to these aircraft:

**HOT REFUELING (AIRCRAFT 163600 THROUGH 163646)**

Perform hot refueling in the following sequence.

**CAUTION**

- The aircraft should not be hot refueled by the gravity fueling method.

- Due to the close proximity of the pressure refuel/defuel coupling to the port engine intake, ground crew should remain clear and aft of engine intake during hot refueling operations.

# APPENDIX C

## AIRCRAFT: T-45

1. Ensure that defueling valve is in the CLOSED position and defueling key removed.

2. Open access door 311EL.

3. Test and record refueling tanker quantity gauge and set flowmeter to zero.

4. Connect tanker grounding cable to static grounding point and aircraft grounding points.

5. Remove blanking caps from pressure fueling/defueling coupling.

6. Connect nozzle grounding jack to aircraft grounding receptacle. Attach nozzle to refuel/defuel coupling.

7. Ensure main refueling switch is set to REFUEL.

**CAUTION**

Failure to place the main refueling switch in the REFUEL position will energize the refuel/transfer valves and result in a fuel spill.

8. Ensure external tanks refueling switches are in the OFF positions.

9. Place tanker control in REFUEL position, and start to pump fuel.

10. Verify that MAIN TANK refueling indicator light is illuminated.

11. If fuel discharges from the fuel vent, stop fueling immediately.

12. Pilot signals to stop refueling at 2,500 pounds of fuel.

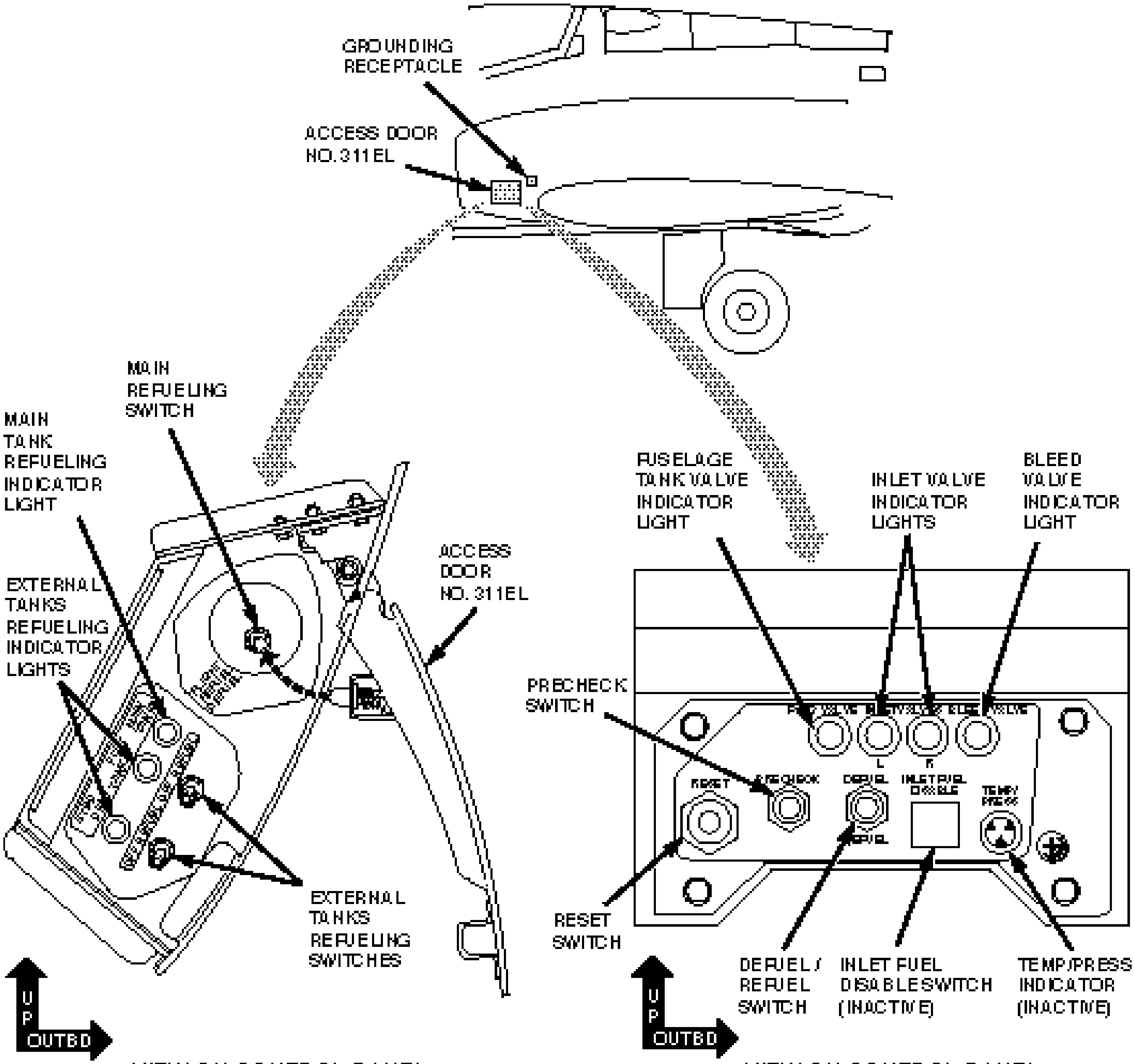
13. Verify that fuel flow stops when tanks are full and MAIN TANK light extinguishes. Stop tanker pump when refueling is complete.

14. Place tanker valve in OFF position. Remove nozzle and disconnect nozzle grounding jack from aircraft grounding receptacle. Install cap on fueling/defueling coupling and align yellow marks. Install sealing cover to nozzle.

# APPENDIX C

## AIRCRAFT: T-45

### GROUND REFUELING PANEL




VIEW ON CONTROL PANEL
(Coupling Omitted for Clarity)

VIEW ON CONTROL PANEL
(Coupling Omitted for Clarity)

**PRESSURE/HOT REFUEL**
**Aircraft 163600 thru 163646**

**PRESSURE/HOT REFUEL**
**Aircraft 163647 and up**

# APPENDIX C

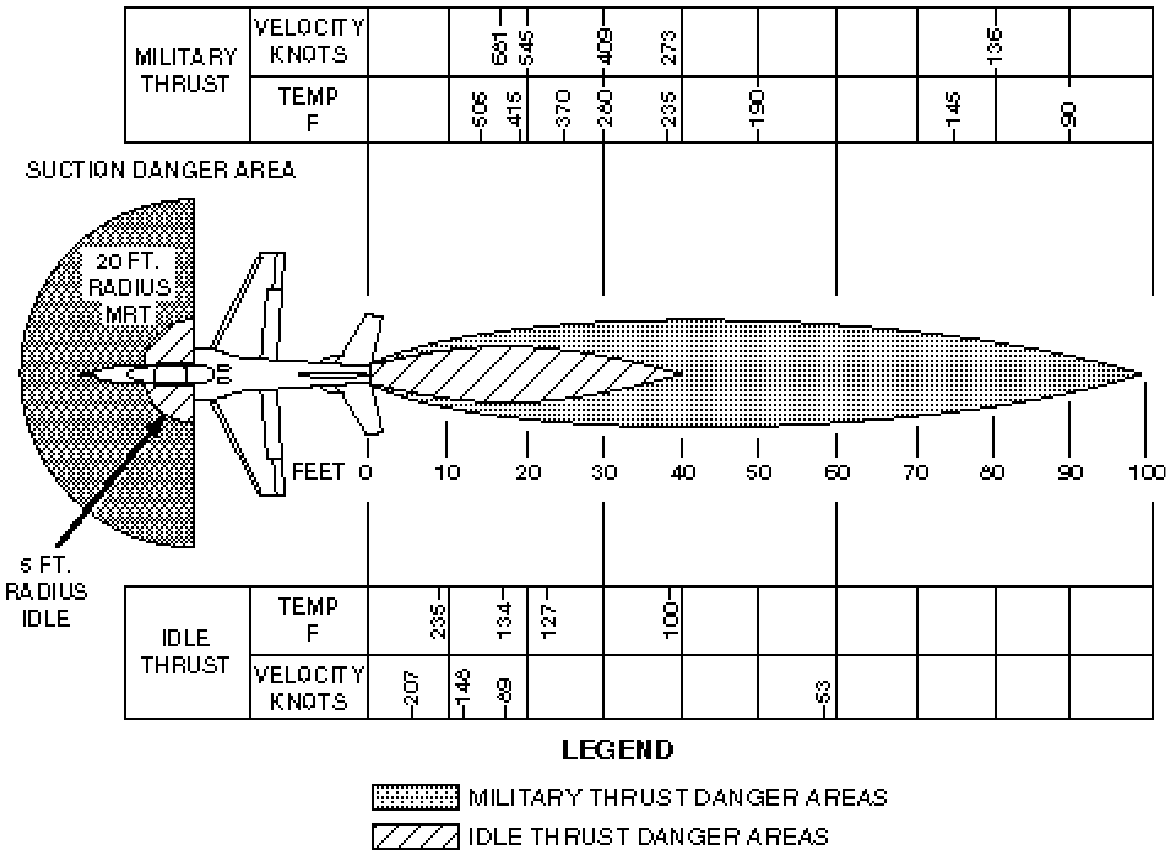
# AIRCRAFT: T-45

## PERSONNEL DANGER ZONES

**WARNING**

- Remove all objects under aircraft. Failure to do so can result in damage to aircraft or injury to personnel.

- Stay clear of area within 100 feet directly behind the aircraft when the engine is operating at MRT.




**CAUTION**

- Make certain that suction danger area is clear of debris.
- Jet blast zone varies according to prevailing wind.

# APPENDIX C

# AIRCRAFT: UC-35

## GENERAL

The Navy UC-35C and UC-35D aircraft are derivatives of the Cessna Citation family of aircraft.

## FUEL CAPACITY

**UC-35C (Aircraft –001 thru –0538)**:

| | |
|---|---|
| Total Left Wing | 433.2 USG |
| Total Right Wing | 433.2 USG |
| Usable Left Wing | 431.0 USG |
| Usable Right Wing | 431.0 USG |

(based on 6.75 pounds/USG)

**UC-35D (Aircraft –0539 and on)**:

| | |
|---|---|
| Total Left Wing | 406.4 USG |
| Total Right Wing | 406.4 USG |
| Usable Left Wing | 403.0 USG |
| Usable Right Wing | 403.0 USG |

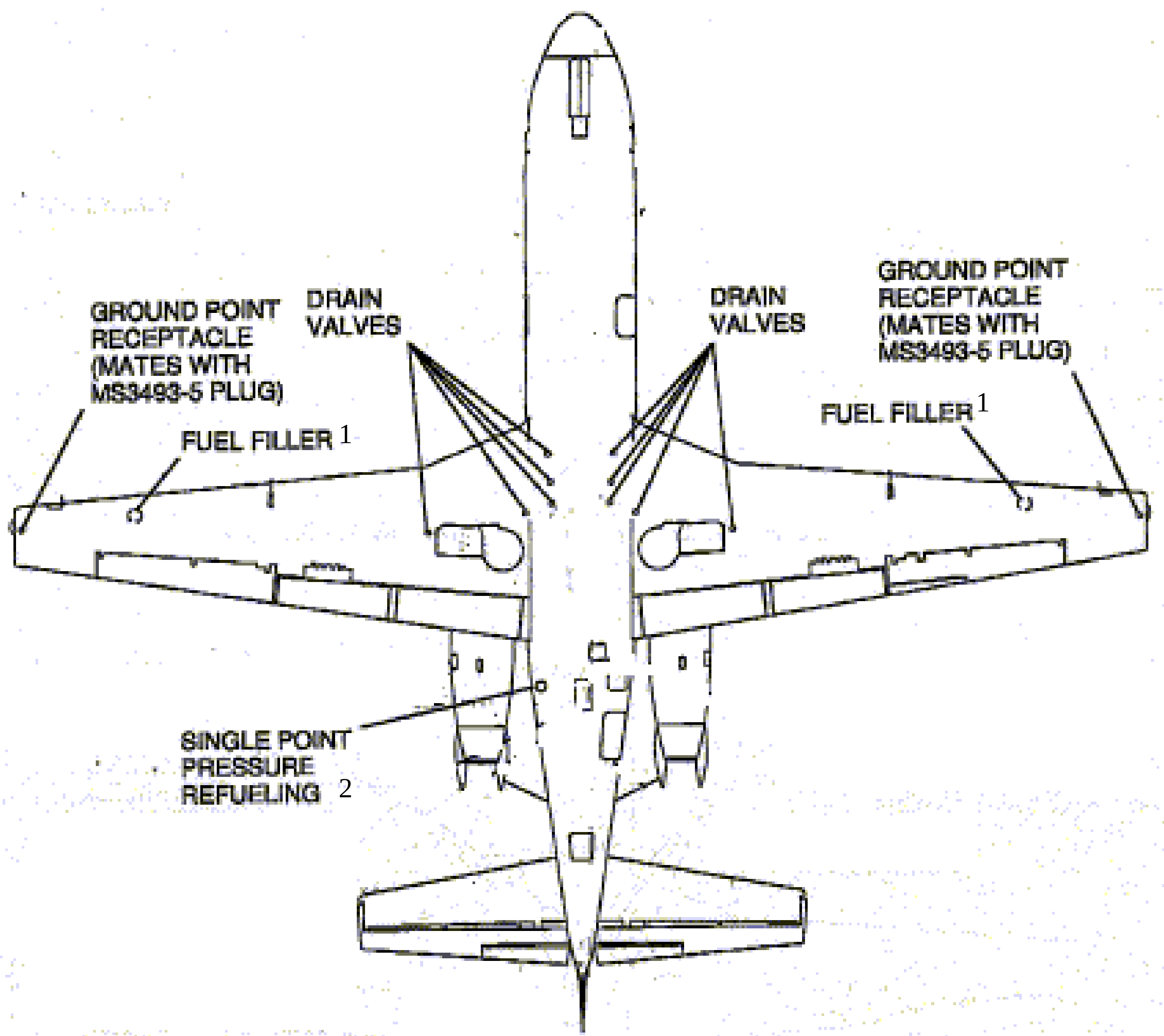
(based on 6.75 pounds/USG)

# APPENDIX C

# AIRCRAFT: UC-35

## AIRCRAFT CONFIGURATION

(Underside, looking up)




Notes: 1. Fuel filler caps are located on topside of wings.
2. SPR adapter is on aircraft -0293; -0307 thru -0538; and -0539 and on.

# APPENDIX C

# AIRCRAFT: UC-35

Overwing Tank Filling Procedures.

WARNING: PERFORM FUEL LOADING IN AREAS THAT PERMIT FREE MOVEMENT OF FIRE EQUIPMENT.

WARNING: ENSURE THAT FUEL SUPPLY UNIT AND AIRPLANE ARE GROUNDED.

(1) Connect fueling nozzle ground to the airplane's grounding receptacle, located on the lower side of the wing, outboard of the filler cap.

(2) Place a protective pad on the wing adjacent to the fuel filler and remove the filler cap.

NOTE: Due to the position of the keyholes, lock freezing may be encountered on airplanes with locking-type filler caps. Heating the key prior to inserting it in the lock will normally thaw the lock; however, putting jet fuel, anti-ice spray or liquid into the lock during inclement weather can reduce the freezing possibilities.

(3) Service as follows:

(a) If the turbine fuel has fuel system icing inhibitor added, fill wing tanks.

(b) If the turbine fuel does not have fuel system icing inhibitor added, select an inhibitor, refer to Tools and Equipment, and add as described by the inhibitor manufacturer or in accordance with Mixing Icing Inhibitor Procedures.

CAUTION: ENSURE FILLER CAP IS SECURED.

(4) Remove fuel nozzle and protective pad, disconnect fueling nozzle ground and install fuel filler cap.

Single-Point Pressure Refueling

CAUTION: ENSURE THE PROPER GRADE AND TYPE OF FUEL ARE USED TO SERVICE THE AIRPLANE.

A. The single-point refueling control panel, if installed, is located on the right side of the fuselage aft of the wing. The control panel consists of the refuel/defuel adapter (receptacle) and a refueling precheck panel. For access to the refueling control panel, open the control panel access door.

WARNING: OBSERVE ALL TECHNICAL AND PERSONAL SAFETY PRECAUTIONS WHEN HANDLING FUEL.

B. Single-Point Refuel Airplane.

NOTE: Single-point fuel pressure at the refueling nozzle should not exceed 60 PSI maximum for airplanes -0001 thru -0538 and should not exceed 50 PSI maximum for airplanes -0539 and on.

# APPENDIX C

# AIRCRAFT: UC-35

NOTE: Fuel flow should not exceed 105 GPM maximum.

CAUTION: PERFORM A REFUELING PRECHECK BEFORE EACH SINGLE-POINT REFUELING.

(1) Verify fire-fighting equipment is readily available.

(2) Open the refuel/defuel control panel access door.

(3) Prepare the airplane for refueling by properly grounding the airplane and refueling vehicle/equipment together with an approved static grounding source. Refer to Safety and Maintenance Precautions.

(4) Ensure the airplane fuel vents are not obstructed.

(5) Remove adapter cap.

(6) Insert the refueling nozzle into the receptacle, turn clockwise and latch in place, open nozzle.

(7) Start fuel flow and perform a system precheck to ensure the pilot valves and/or fuel shutoff valves are operating properly.

(a) On the precheck panel, open the left and right precheck valves. Within 10 seconds, the refueling operation should shut down as indicated by the refueling equipment flow meter or the flow totalizer.

NOTE: Each high level pilot valve requires a maximum of 3 GPM for precheck. Therefore, fuel flow rate during precheck could be 6 GPM for the left and right wing tanks. If a refueling shutdown does not occur, discontinue the refueling operation and correct the malfunction. Refer to Chapter 28, Single-Point Refueling/Defueling System - Maintenance Practices .

(b) Close the precheck valves and continue the refueling operation.

(8) When the airplane fuel reservoirs become full, the high level pilot valves cause the fuel shutoff valves to close and fuel flow is discontinued automatically. Shut down pumping equipment (vehicle or hydrant equipment).

NOTE: An indication of fuel flow stoppage is when the pumping equipment flow meter or flow totalizer indicates no fuel flow.

(9) Verify the airplane fuel reservoirs are fully serviced by operating and checking the fuel quantity indicators.

(10) Disconnect the refueling nozzle from the adapter (receptacle), install adapter cap.

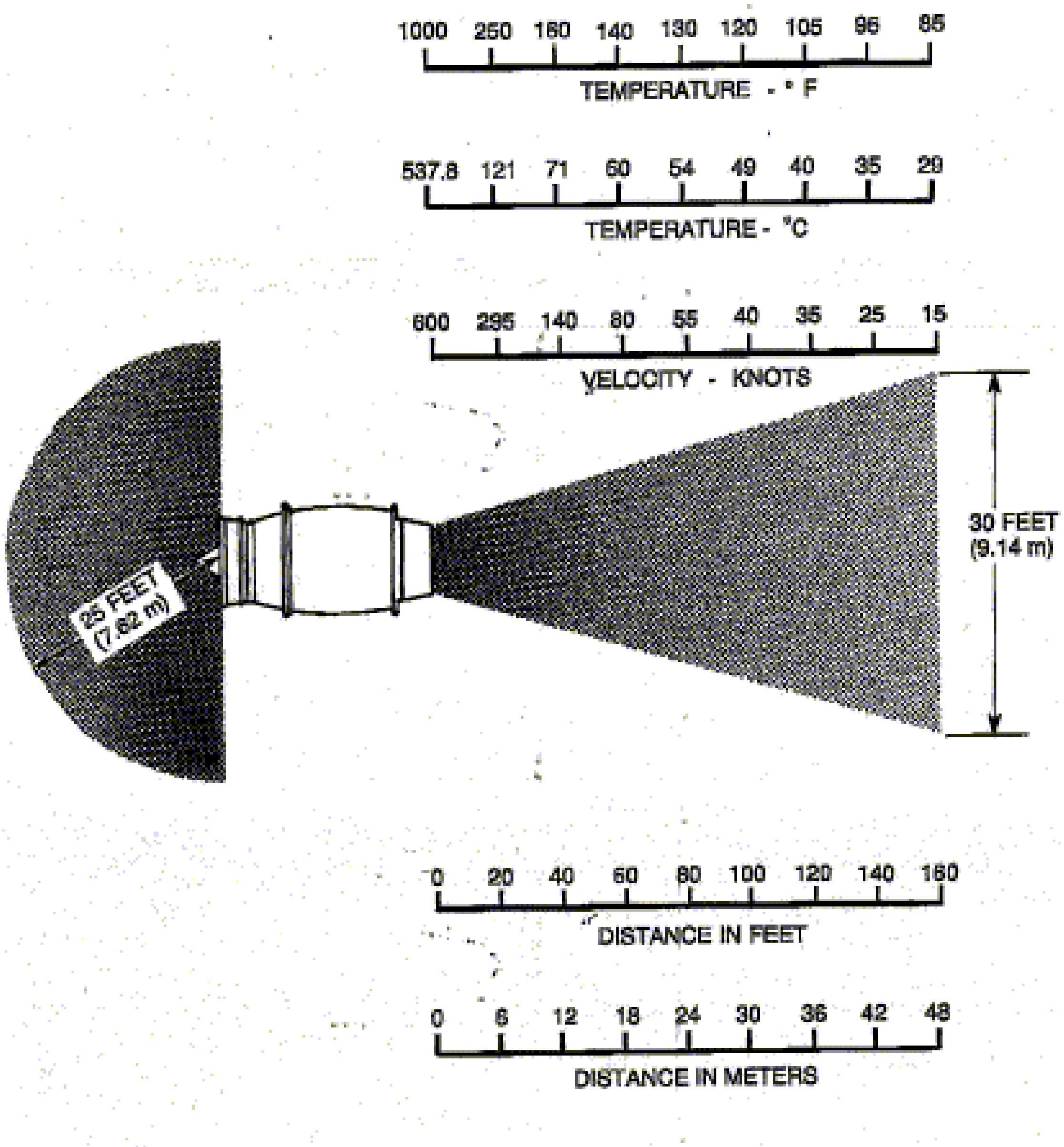
(11) Close and secure the refuel/defuel control panel access door.

(12) Remove all grounding cables and move the airplane or refueling vehicle from the area.

# APPENDIX C

## AIRCRAFT: UC-35

### DANGER AREAS (1 of 2)

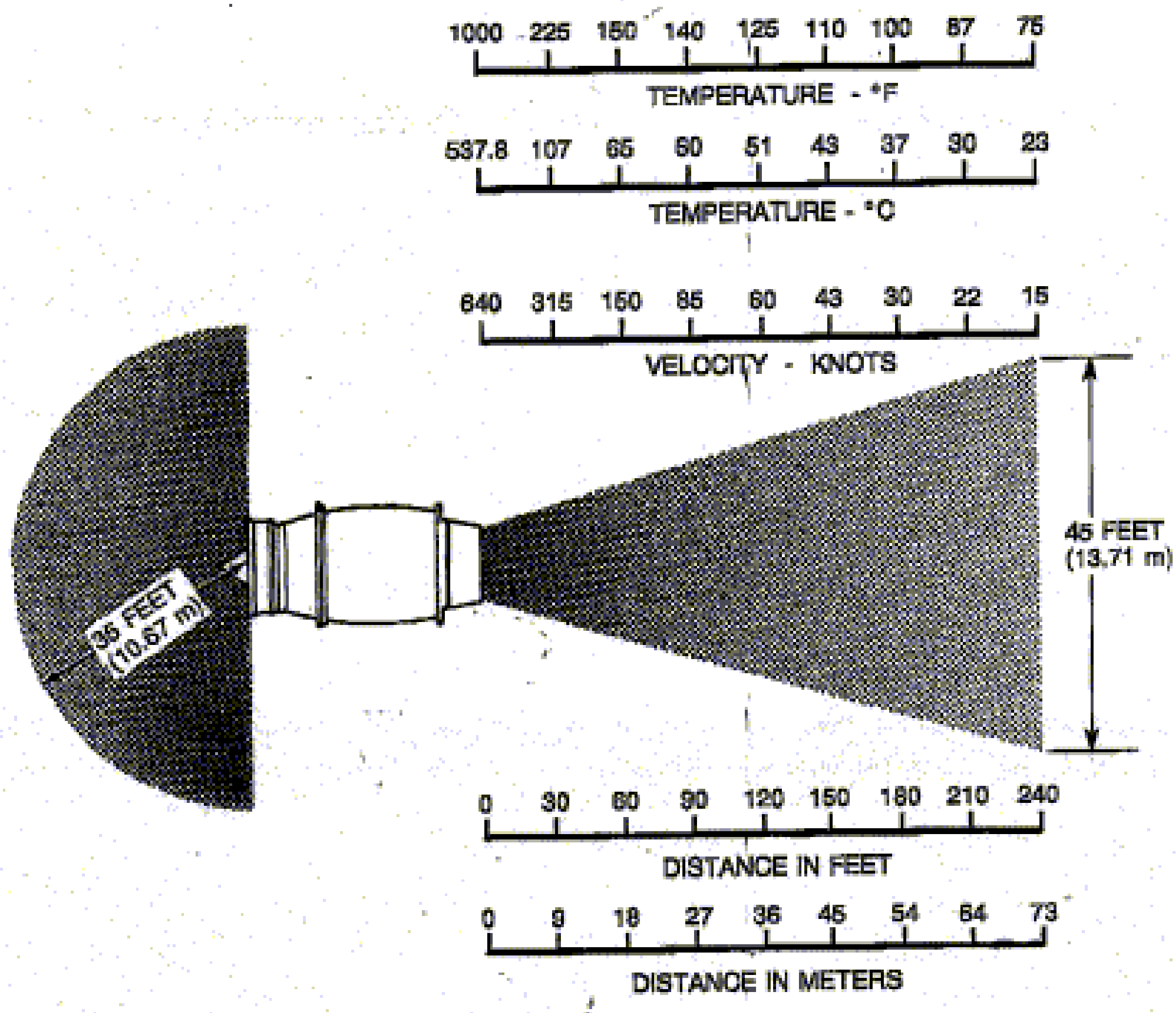



AIRPLANES -0001 THRU -0538

# APPENDIX C

## AIRCRAFT: UC-35

### DANGER AREAS (2 OF 2)

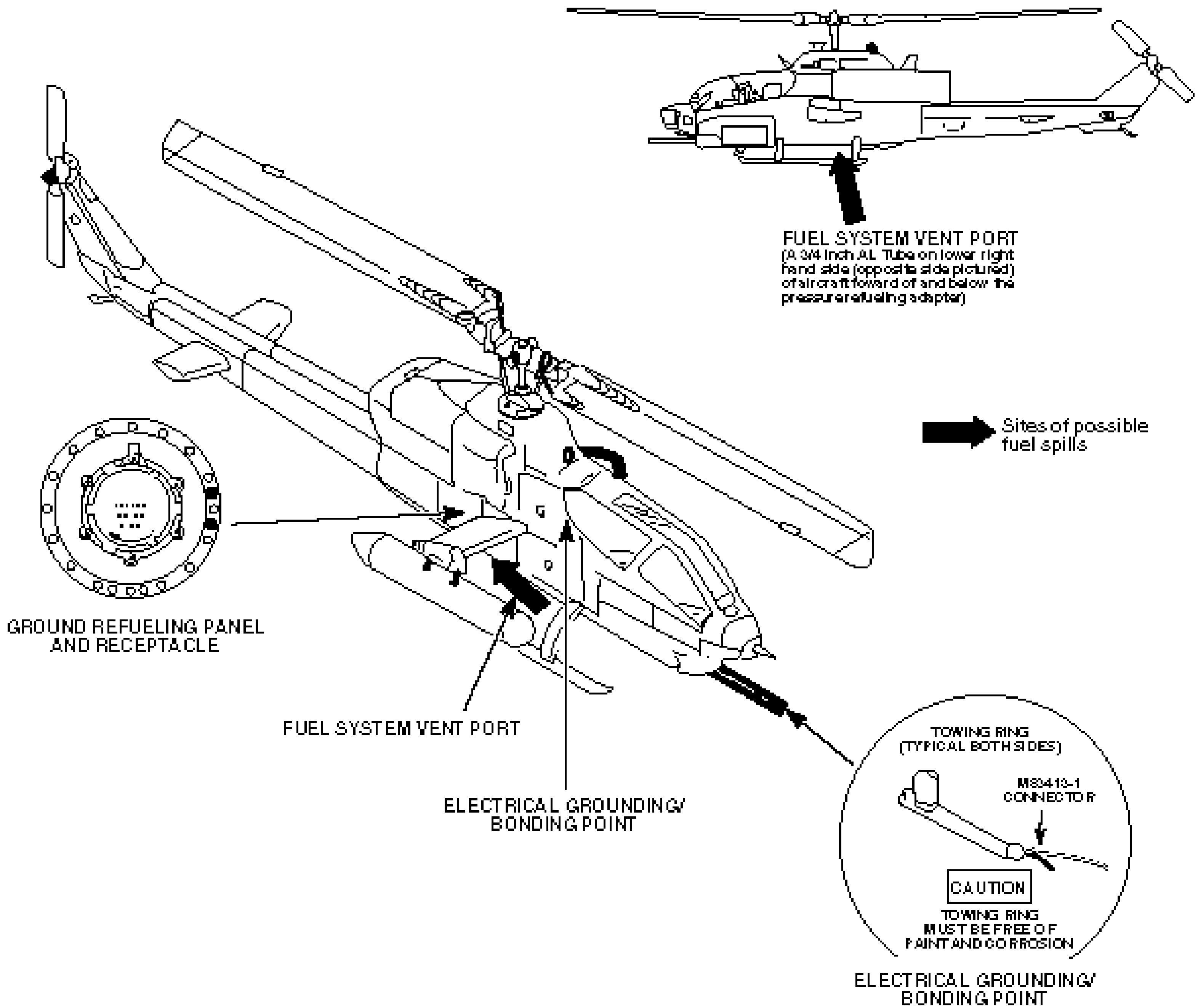



AIRPLANES -0539 AND ON

# APPENDIX C

# AIRCRAFT: AH-1

## AIRCRAFT CONFIGURATION



# APPENDIX C

## AIRCRAFT: AH-1

### TABLE OF FUEL CAPACITIES

| Tank | | Gallons |
|---|---|---|
| Internal | Forward | 190 |
| | Aft | 123 |
| | Total | 313 |
| External Wing Tanks (each) | 2 Maximum | 100 |
| | 4 Maximum | 77 |

### AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Fuselage Width | 10 ft 9 in | Maximum Gross Weight — 14,750 lbs |
| Length | 58 ft | Maximum Footprint — 70 psi |
| Height | 14 ft 2 in | |

### AH-1 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the AH-1 aircraft, primarily the operation of the “precheck” system. In addition to these specialized procedures, the applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

1. Remove receptacle cap, attach refueling nozzle, open nozzle to the fully open and locked position, and initiate fuel flow.

**WARNING**

Ensure that air is venting from “FUEL SYSTEM VENTS.” If no venting is indicated, cease fueling operation immediately.

2. Exercise the Precheck system. Press and hold one of the “PRECHECK” plungers on the rim of the fueling valve. Fuel flow into the aircraft should stop within 20 seconds. Release the “PRECHECK” plunger and fuel flow should resume into the aircraft.

3. Repeat the last step this time holding the other “PRECHECK” plunger down.

# APPENDIX C

# AIRCRAFT: AH-1

**WARNING**

Flow of fuel while either of the "PRECHECK" plungers is held down indicates a failed shutoff valve. Stop refueling immediately. System failure should be investigated and resolved before hot refueling can be accomplished.

4. Release both "PRECHECK" plungers and refuel aircraft.

5. Continue fueling until fuel flow stops automatically.

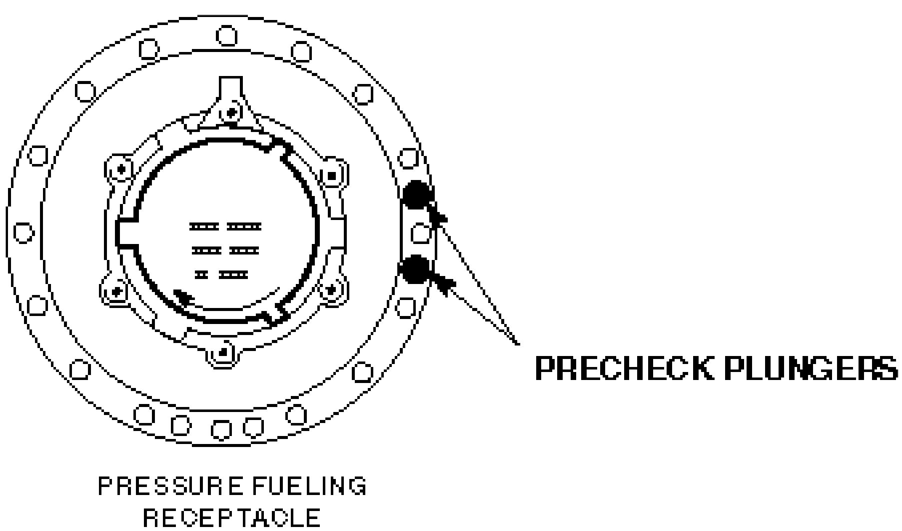
**SPECIAL NOTES — AIRCRAFT FUEL SYSTEM**

1. Under normal conditions, all air being displaced by fuel in the tanks exits the aircraft through the common "Fuel System Vent Port," which is a 3/4-inch AL Tube on the lower right-hand side of the aircraft forward of and below the pressure refueling adapter. It is almost on the bottom of the aircraft.

2. If any high level shut-off valves fail to operate correctly, fuel may spill from one of the "Fuel System Vent Ports." In addition, the fuel tanks may rupture and spill fuel.

3. The external tanks can not be pressure refueled. Each external tank should be gravity refueled separately.

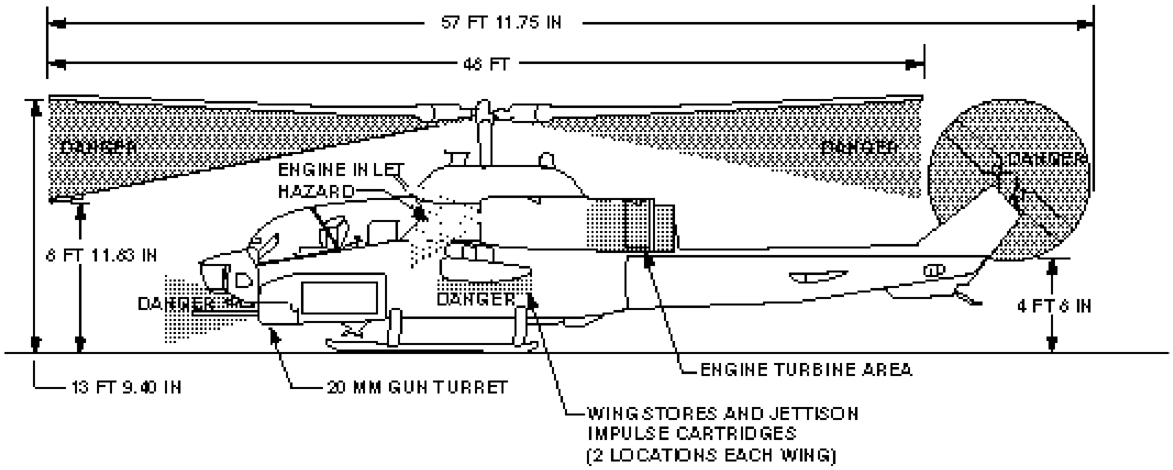
**GROUND REFUELING PANEL**

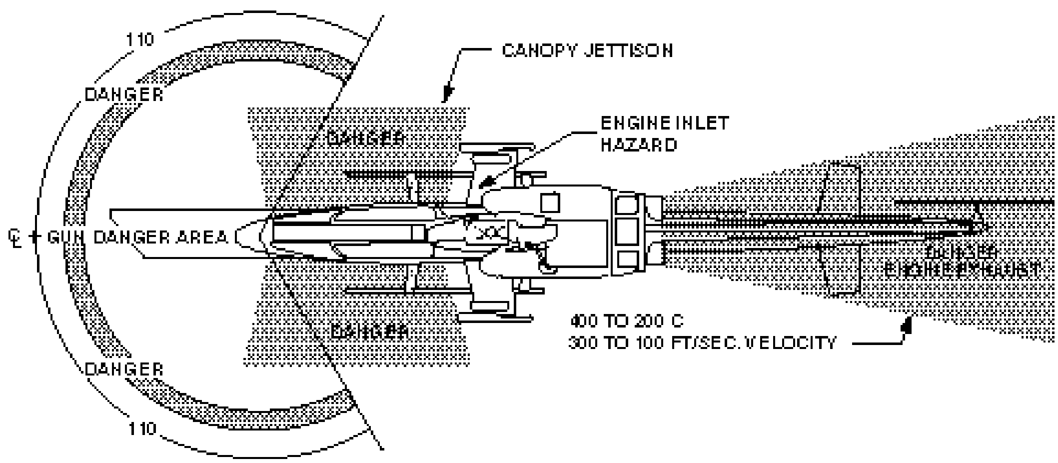


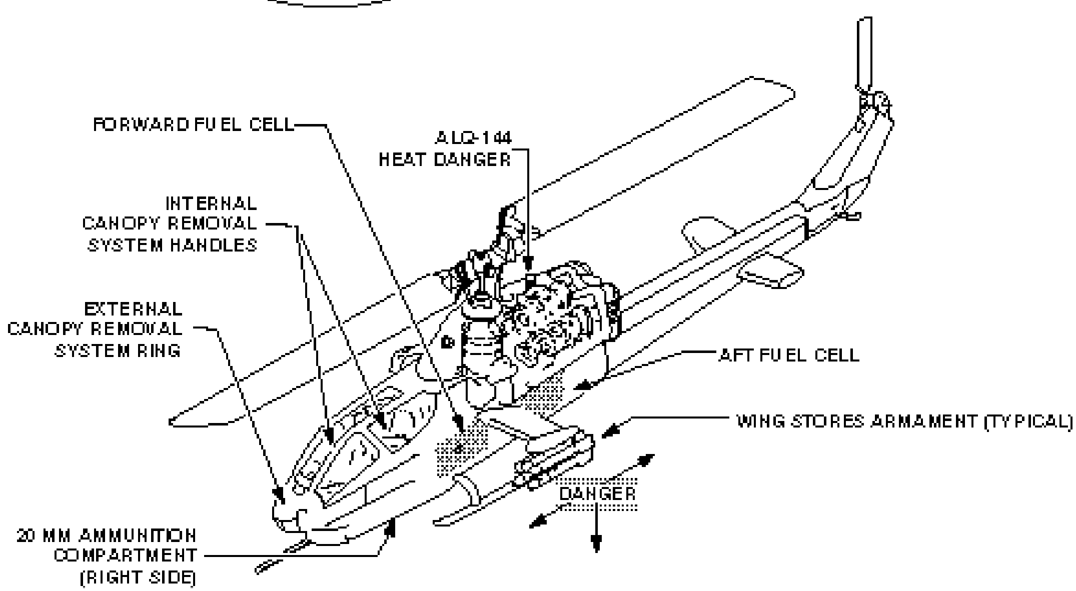
# APPENDIX C

# AIRCRAFT: AH-1

## PERSONNEL DANGER ZONES



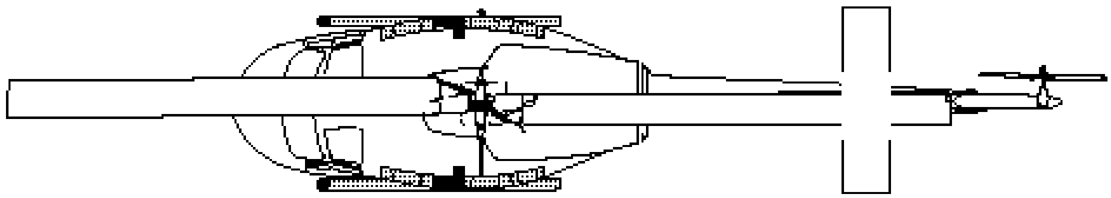



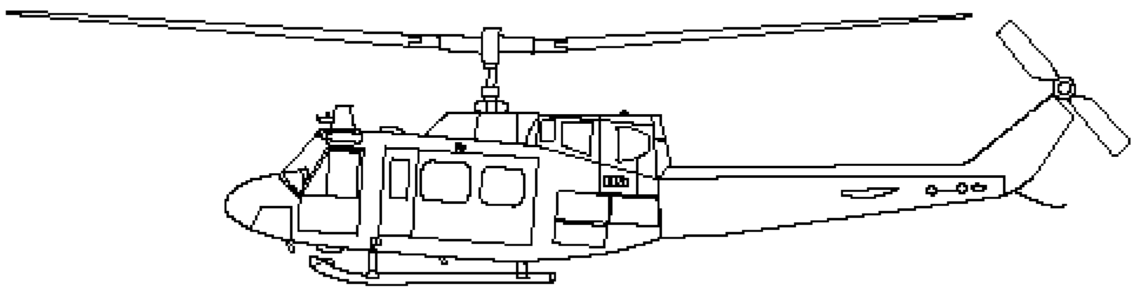



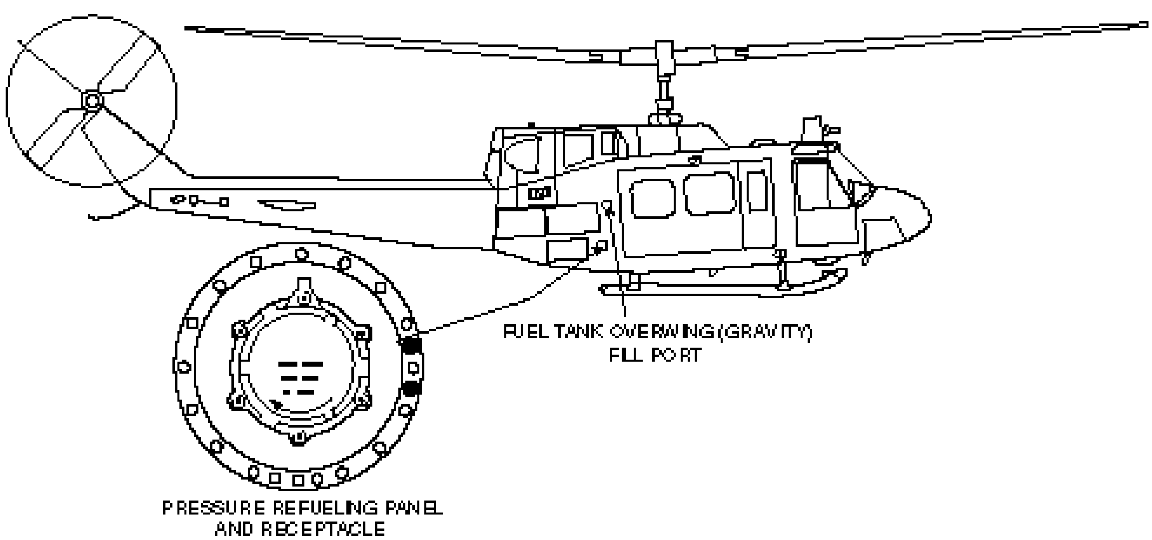
# APPENDIX C

# AIRCRAFT: H/UH-1

## AIRCRAFT CONFIGURATION







# APPENDIX C

# AIRCRAFT: H/UH-1

## TABLE OF FUEL CAPACITIES

| U.S. GALLONS AND POUNDS | | |
|---|---|---|
| | **MAX CAPACITY** | **USABLE FUEL** |
| MAIN FUEL TANKS | 195.5 Gallons<br>1,271 Pounds JP-4<br>1,329.5 Pounds JP-5<br>1,316 Pounds JP-8 | 193 Gallons<br>1,254.5 Pounds JP-4<br>1,312.5 Pounds JP-5<br>1,299 Pounds JP-8 |
| AUXILIARY FUEL TANKS | (Both Tanks)<br>300 Gallons<br><br>1,950 Pounds JP-4<br>2,040 Pounds JP-5<br>2,019 Pounds JP-8 | (Both Tanks)<br>300 Gallons<br><br>1,950 Pounds JP-4<br>2,040 Pounds JP-5<br>2,019 Pounds JP-8 |

## AIRCRAFT CHARACTERISTICS

| **Aircraft Dimensions** | | **Aircraft Weight** |
|---|---|---|
| Fuselage<br><br>Width | 9 ft 1 in | Maximum Gross Weight — 10,500 lbs |
| Length | 57 ft 3.3 in | |
| Height | 13 ft 1 in | |

## UH-1 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the UH-1 aircraft, primarily the operation of the “precheck” system. In addition to these specialized procedures, the applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

1. Remove receptacle cap, attach refueling nozzle, open nozzle to the fully open and locked position, and initiate fuel flow.

**WARNING**

Ensure that air is venting from “FUEL SYSTEM VENTS.” If no venting is indicated, cease fueling operation immediately.

## APPENDIX C

## AIRCRAFT: H/UH-1

2. Exercise the Precheck system. Press and hold one of the “PRECHECK” plungers on the rim of the fueling valve. Fuel flow into the aircraft should stop within 20 seconds. Release the “PRECHECK” plunger and fuel flow should resume into the aircraft.

3. Repeat the last step this time holding the other “PRECHECK” plunger down.

**WARNING**

Flow of fuel while either of the “PRECHECK” plungers is held down indicates a failed shutoff valve. Stop refueling immediately. System failure should be investigated and resolved before hot refueling can be accomplished.

4. Release both “PRECHECK” plungers and refuel aircraft.

5. Continue fueling until fuel flow stops automatically.

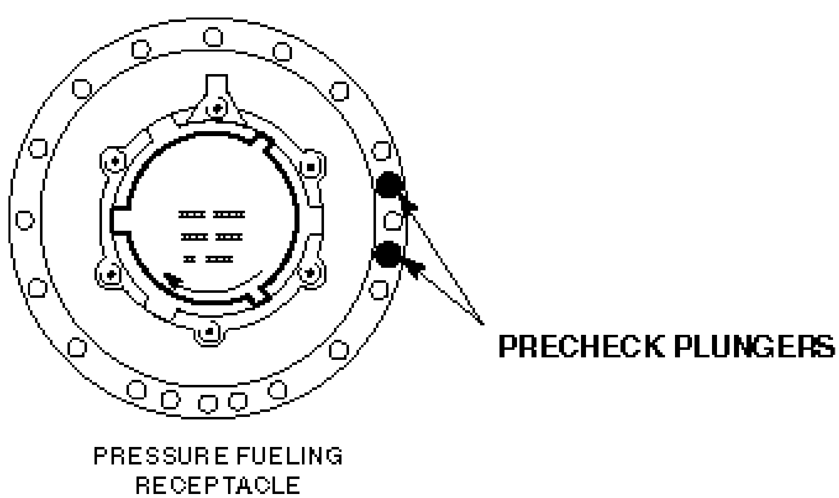
**SPECIAL NOTES — AIRCRAFT FUEL SYSTEM**

1. Under normal conditions, all air being displaced by fuel in the tanks exits the aircraft through the common “Fuel System Vent Port,” through the fuselage lower skin.

2. If any high level shut-off valves fail to operate correctly, fuel may spill from one of the “Fuel System Vent Ports.” In addition, the fuel tanks may rupture and spill fuel.

3. The external tanks can not be pressure refueled. Each external tank should be gravity refueled separately.

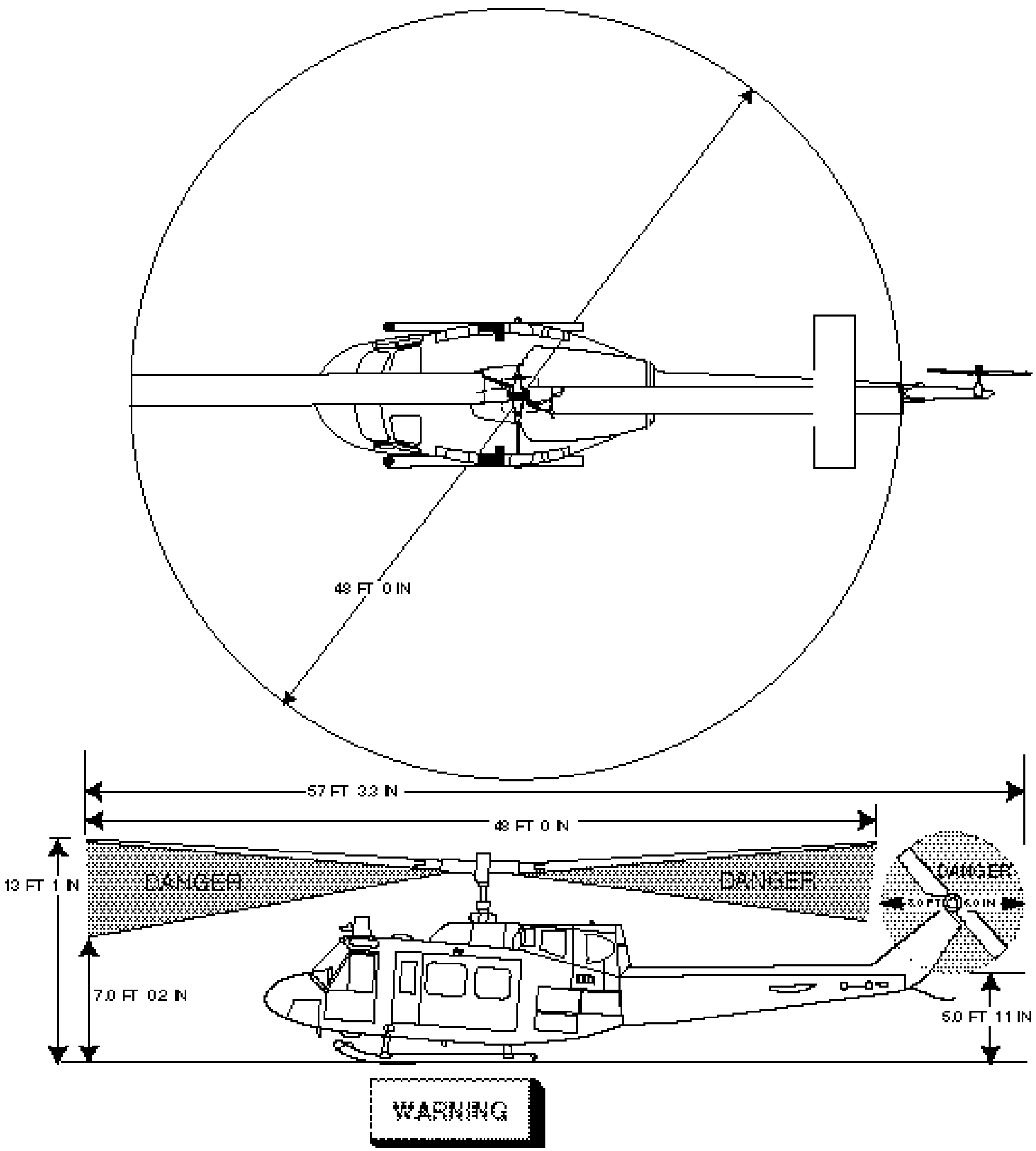
**GROUND REFUELING PANEL**



# APPENDIX C

# AIRCRAFT: H/UH-1

## PERSONNEL DANGER ZONES

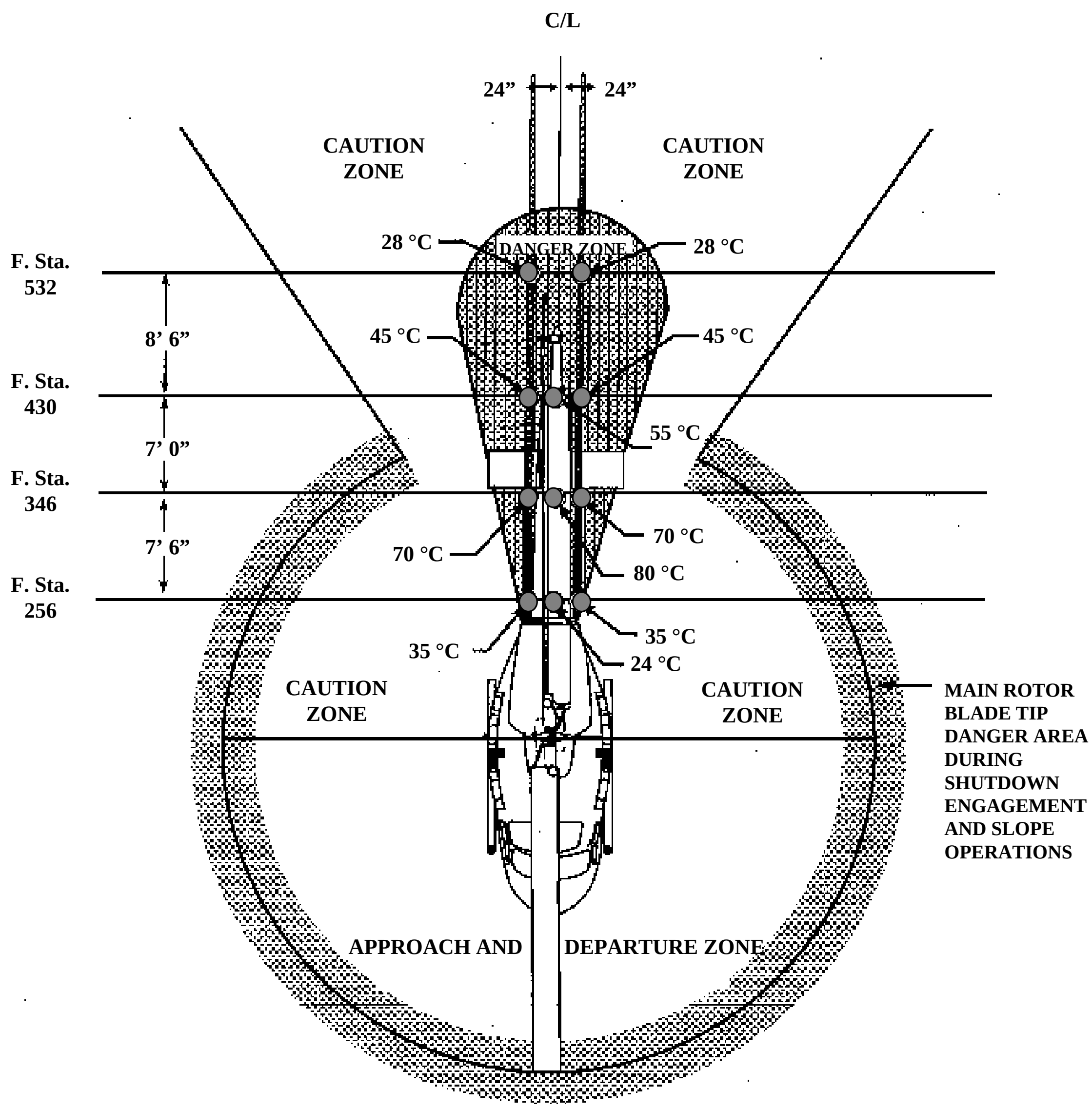



Rotor blade may flap down as low as 5 feet.

## APPENDIX C

## AIRCRAFT H/UH-1

**PERSONNEL DANGER ZONES (**Continued)

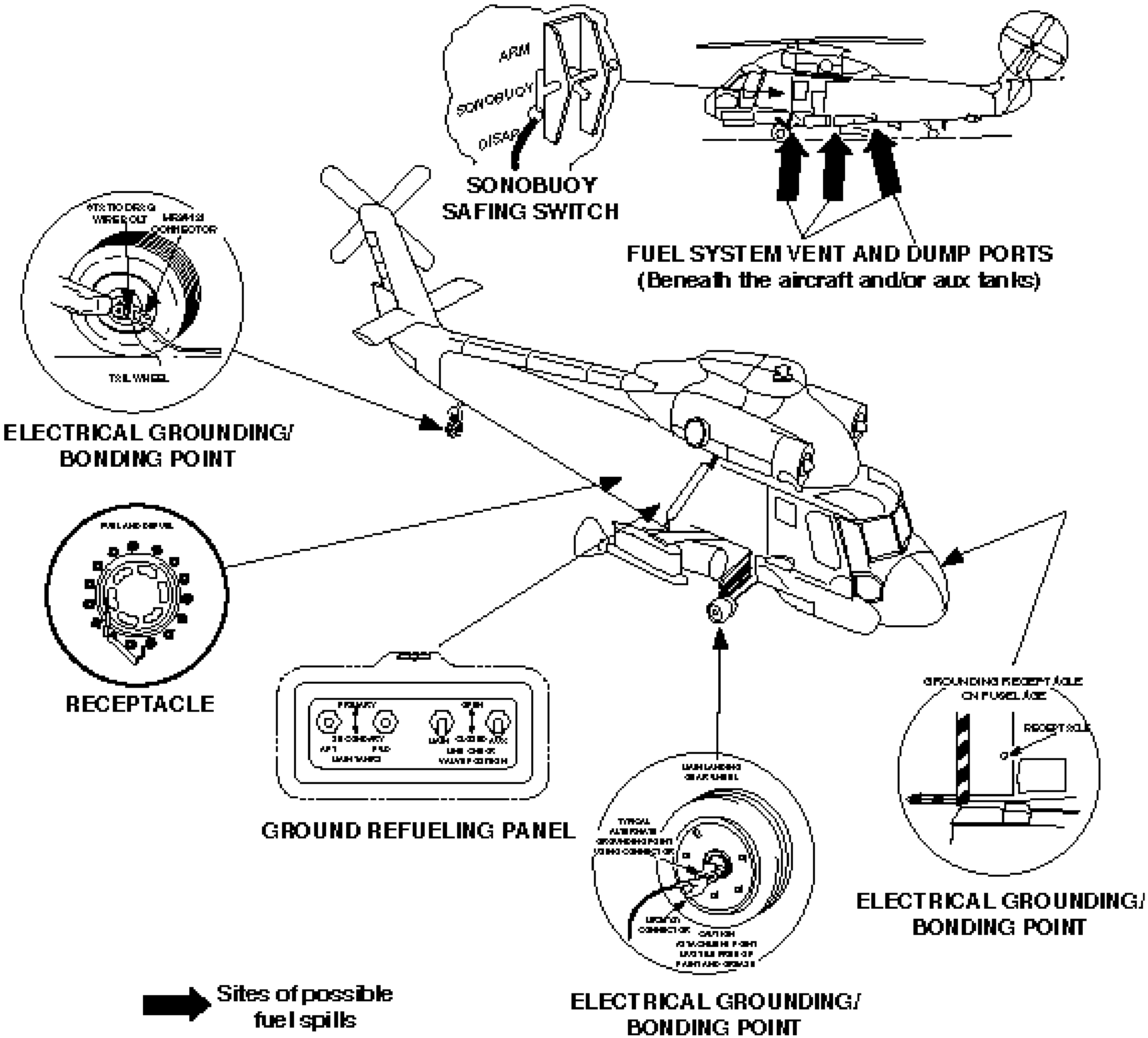



**TEMPERATURES SHOWN ARE AT HEIGHT OF 6 FEET ABOVE GROUND LEVEL, WITH HELICOPTER OPERATING AT TAKE-OFF POWER ON GROUND RUN.**

APPENDIX C

AIRCRAFT: H-2

AIRCRAFT CONFIGURATION



# APPENDIX C

## AIRCRAFT: H-2

### TABLE OF FUEL CAPACITIES

| Tank | | | Gallons |
|---|---|---|---|
| | Internal | Sump | 99 |
| | | Aft | 176 |
| | | Total | 275 |
| Ext Aux Tanks (each) | Before AFC 293 | | 59 |
| | After AFC 293 | | 99 |
| Totals (With 2 Aux Tanks) | Before AFC 293 | | 393 |
| | After AFC 293 | | 473 |

### AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Fuselage Width | 12 ft | Maximum Gross Weight — 13,500 lbs |
| Length | 52 ft 0.3 in | Maximum Footprint — 225 psi |
| Height | 14 ft 4.3 in | |

### H-2 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the H-2 aircraft, primarily the operation of the “precheck” system. In addition to these specialized procedures, the applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

**CAUTION**

Sonobouy Safing Switch on the SH-3 aircraft should be placed in the “DISARM” position prior to the initiation of the hot refueling operation.

1. Remove receptacle cap and attach refueling nozzle.
2. Open Ground Refueling Panel door. Place the “MAIN” and “AUX” “LINE SWING CHECK VALVE SWITCHES,” in the “CLOSED” position.
3. Initiate fuel flow into the aircraft.

## APPENDIX C

## AIRCRAFT: H-2

4. Exercise the Precheck system. Press and hold both "PRECHECK SWITCHES" on the Ground Refueling Panel to "SECONDARY" position. Fuel flow into the aircraft should stop within 20 seconds. Repeat the last step this time holding both "PRECHECK SWITCHES" in the primary holding position.

**WARNING**

Flow of fuel while precheck switches are in the "SECONDARY" or "PRIMARY" positions indicates a failed shutoff valve. Stop refueling immediately. System failure should be investigated and resolved before hot refueling can be accomplished.

5. Return both "PRECHECK SWITCHES" on Ground Refueling Panel to their normal positions.
6. Stop the flow of fuel into the aircraft by closing the poppet valve on the aircraft refueling nozzle.
7. Place the "AUX" and "MAIN" "LINE WING CHECK VALVE SWITCHES" in the "OPEN" position.
8. Open refueling nozzle poppet valve and refuel aircraft.
9. Continue fueling until fuel flow stops automatically.

**SPECIAL NOTES — AIRCRAFT FUEL SYSTEM**

1. Under normal conditions, all air being displaced by fuel in the tanks exits the aircraft through the common "Fuel System Vent Ports," which are located on the bottom of the aircraft and the auxiliary tanks (if installed).

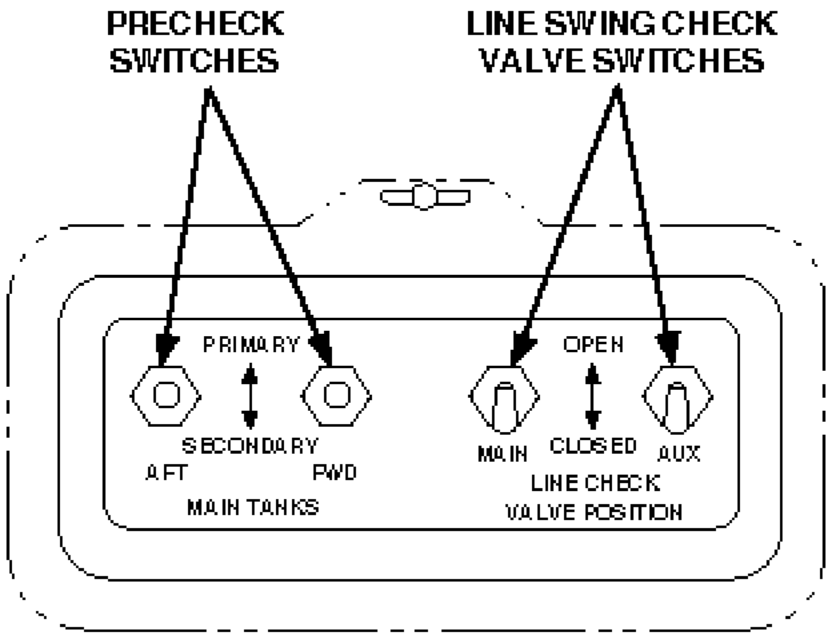
2. If any high-level shut-off valves fail to operate correctly, fuel may spill from one of the "Fuel System Vent Ports." In addition, the fuel tanks may rupture and spill fuel.

3. The "LINE WING CHECK VALVE SWITCHES" can be used to selectively refuel only the main internal tanks on the aircraft. Place both of these switches in the "OPEN" position to obtain maximum fuel load (including auxiliary tanks).

# APPENDIX C

## AIRCRAFT: H-2

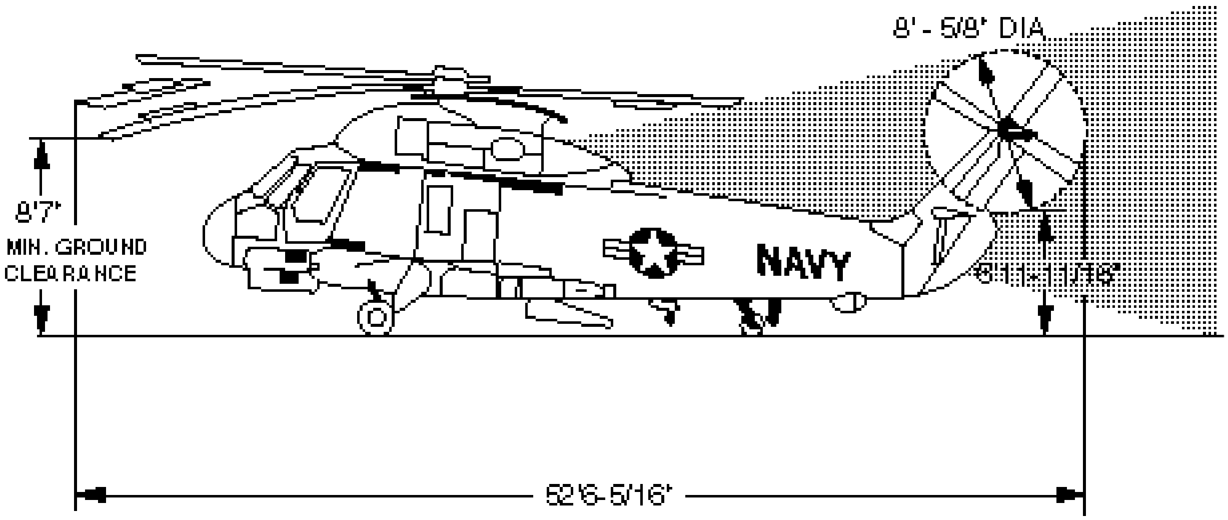
### GROUND REFUELING PANEL

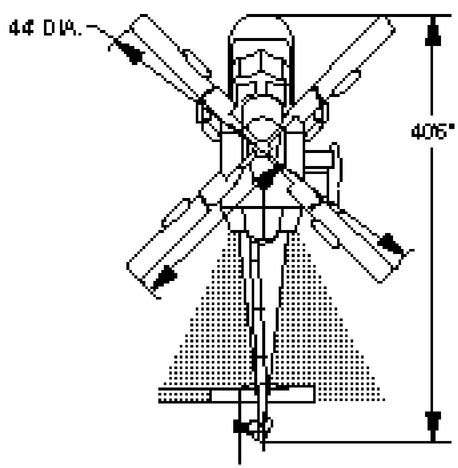


# APPENDIX C

## AIRCRAFT: H-2

### PERSONNEL DANGER ZONES

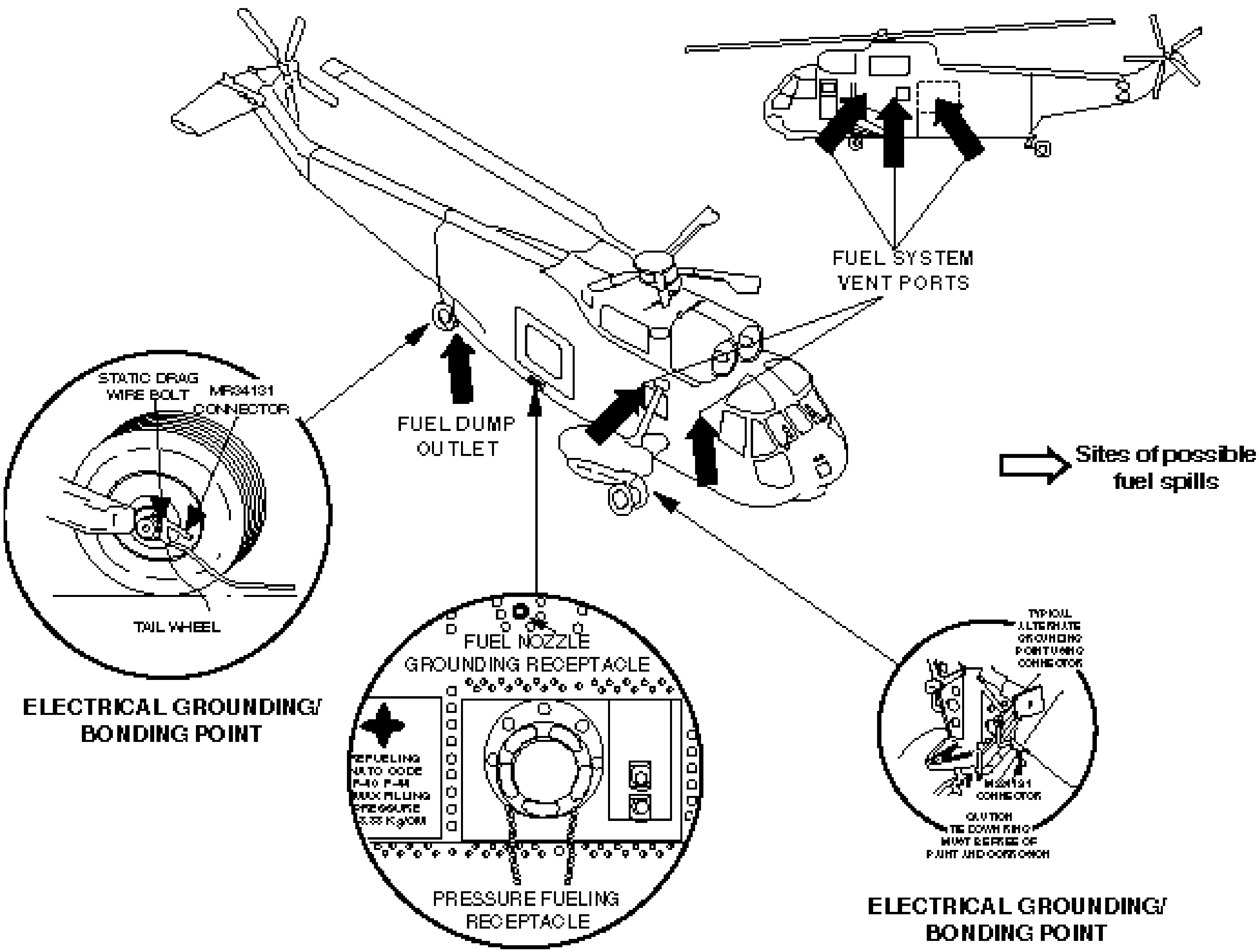


# APPENDIX C

## AIRCRAFT: H-3

### AIRCRAFT CONFIGURATION




ELECTRICAL GROUNDING/
BONDING POINT

GROUND REFUELING PANEL AND RECEPTACLE

ELECTRICAL GROUNDING/
BONDING POINT

# APPENDIX C

## AIRCRAFT: H-3

### TABLE OF FUEL CAPACITIES

| Tank | | Gallons |
|---|---|---|
| Internal | Forward | 341 |
| | Aft | 344 |
| | Total | 685 |

### AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Fuselage Width | 14 ft | Maximum Gross Weight — 20,000 lbs |
| Length | 72 ft 8 in | Maximum Footprint — 90 psi |
| Height | 16 ft 10 in | |

### H-3 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the H-3 aircraft, primarily the operation of the “precheck” system. In addition to these specialized procedures, the applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

1. Open Ground Refueling Panel access door. (VH-3 only)
2. Remove receptacle cap, attach refueling nozzle, open nozzle to the fully open and locked position, and initiate fuel flow.
3. Press and hold the switch on the Ground Refueling Panel labeled “PRI TEST.” Fuel flow should stop within 10 seconds.
4. Release the “PRI TEST” switch and resume fuel flow.
5. Repeat the precheck process in step 4 above, this time pressing and holding the “SEC TEST” switch. Again fuel flow should stop within 10 seconds.

**CAUTION**

If fuel flow does not stop in steps 3 or 5 above, discontinue hot refueling operation immediately. System failure should be investigated and resolved before hot refueling can be accomplished.

6. Release precheck switches and refuel aircraft until fuel flow into the aircraft automatically stops indicating the aircraft's tanks are full.

# APPENDIX C

# AIRCRAFT: H-3

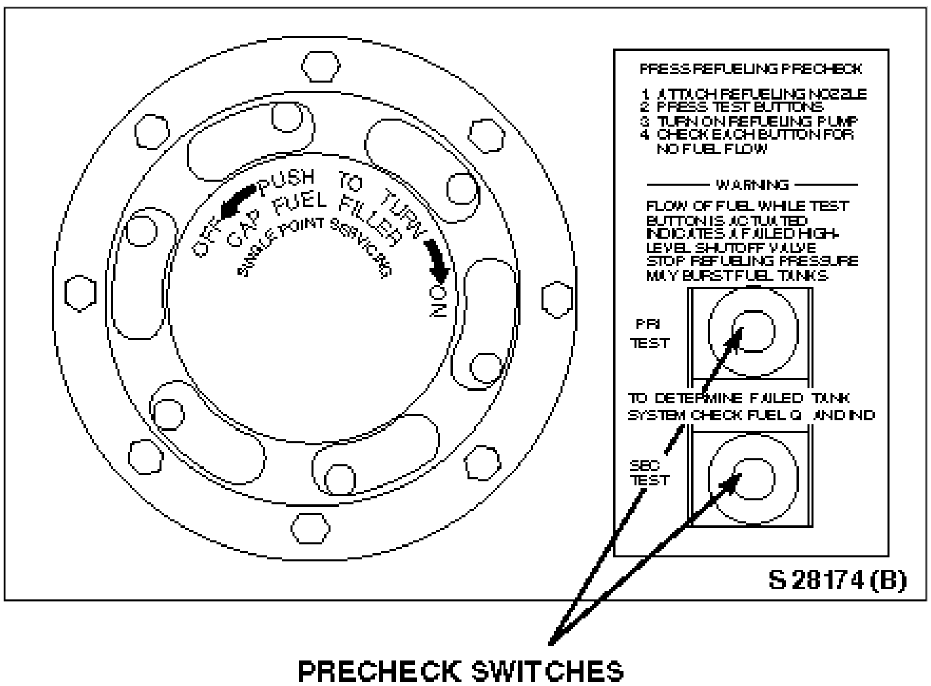
## SPECIAL NOTES — AIRCRAFT FUEL SYSTEM

1. Under normal conditions, all air being displaced by fuel in the tanks exits the aircraft through the common “Fuel System Vent Ports,” which are located on the cabin skin in the approximate places indicated on the aircraft configuration diagram.

2. If any high-level shut-off valves fail to operate correctly, fuel may spill from one of the “Fuel System Vent Ports.” In addition, the fuel tanks may rupture and spill fuel.

3. If externally mounted auxiliary tanks are installed, they can be refueled only by gravity. It is not recommended that these tanks be hot refueled.

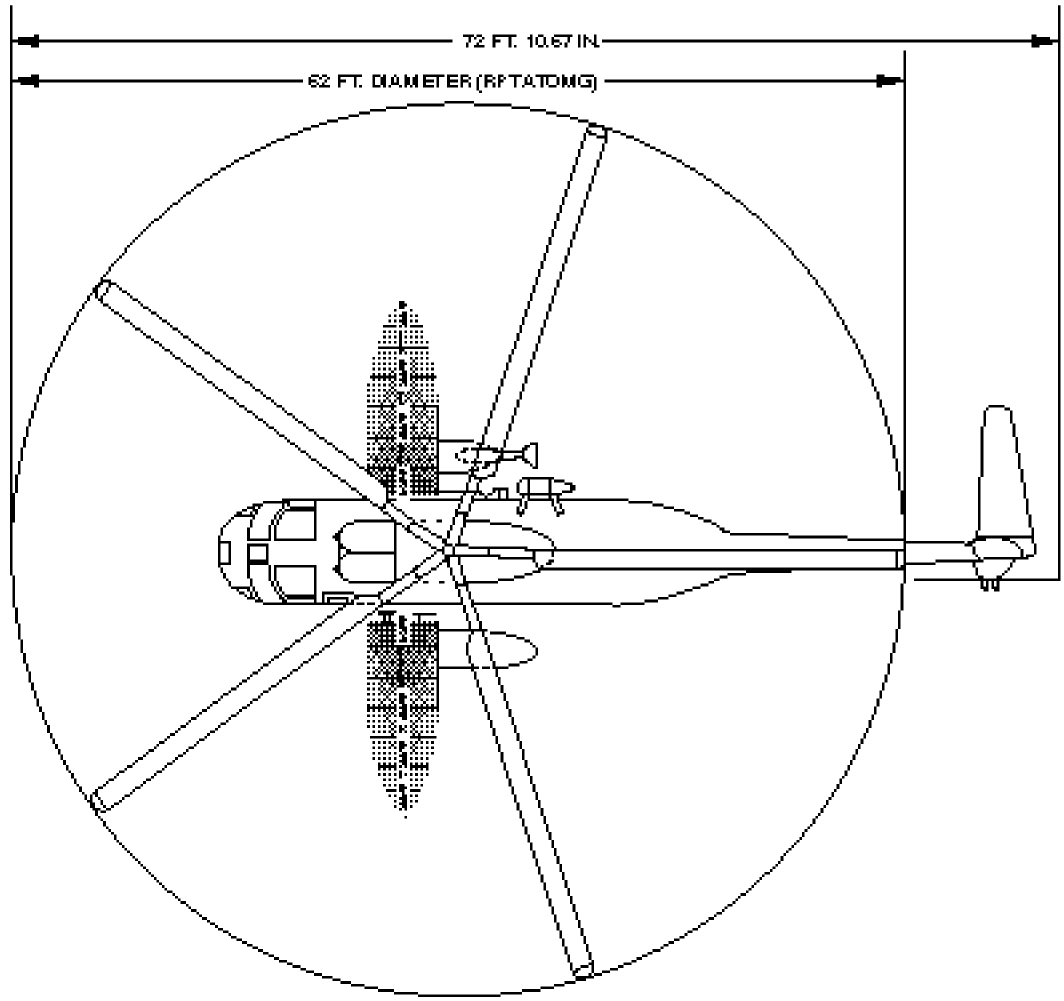
### GROUND REFUELING PANEL

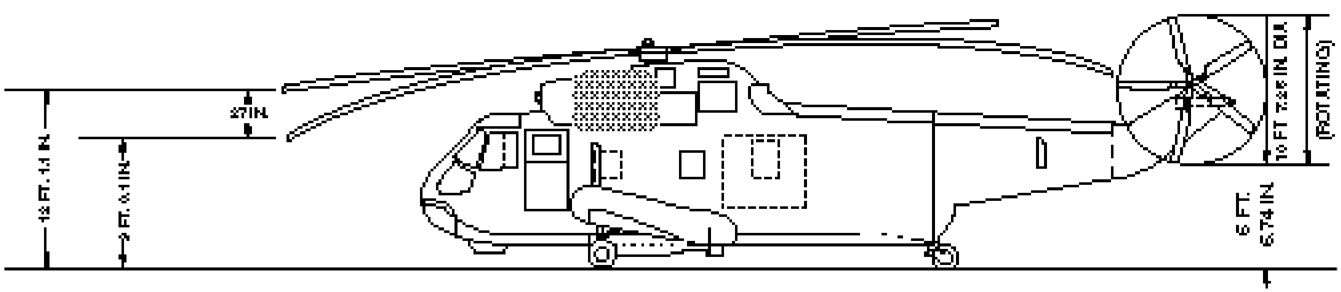


# APPENDIX C

## AIRCRAFT: H-3

### PERSONNEL DANGER ZONES

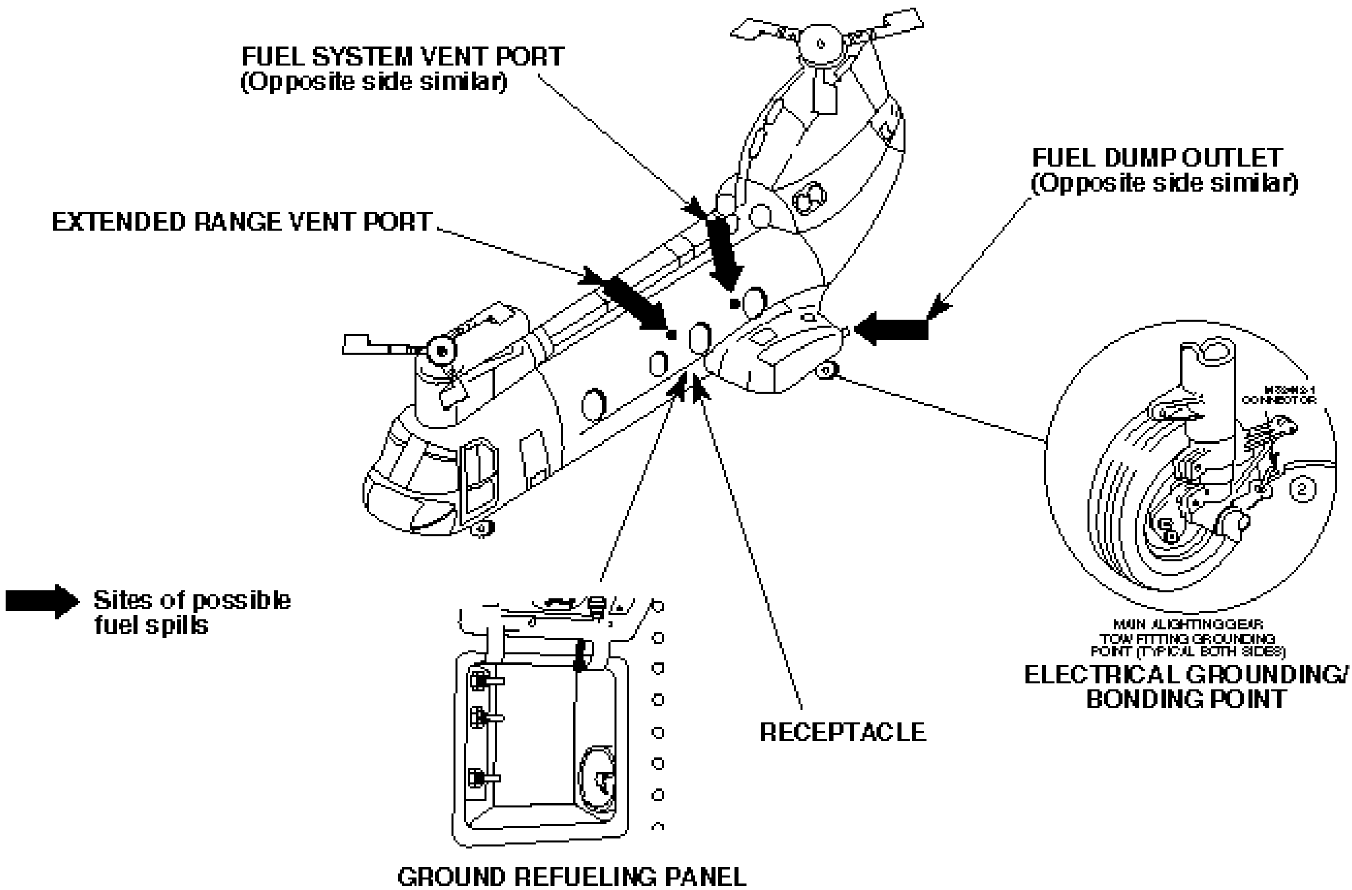


# APPENDIX C

## AIRCRAFT: H-46 Series

### AIRCRAFT CONFIGURATION



# APPENDIX C

## AIRCRAFT: H-46 Series

### TABLE OF FUEL CAPACITIES

| Tank | | Gallons |
|---|---|---|
| Stubwing | Left | 190* |
| | Right | 190* |
| Total Internal | | 380 |
| Extended Range Tanks (Each) Maximum of Three | | 250 |
| *Certain aircraft have special extended capacity in their stubwing tanks — 330 gal each. | | |

### AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Fuselage Width | 14 ft 9 in | Maximum Gross Weight — 23,000 lbs |
| Length | 84 ft 4 in | Maximum Footprint — 170 psi |
| Height | 18 ft 4 in | |

### H-46 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the H-46 aircraft, primarily the operation of the “precheck” system. In addition to these specialized procedures, the applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

1. Open Ground Refueling Panel access door.

2. Remove receptacle cap, attach refueling nozzle, open nozzle to the fully open and locked position, and initiate fuel flow.

**WARNING**

Ensure that air is venting from “FUEL SYSTEM VENTS.” If no venting is indicated, cease fueling operation immediately.

3. Locate the Precheck system valve test switches on the ground refueling panel. Hold left “VALV CONT” switch to “PRI CLOSE” and the right “VALV CONT” switch to “SEC CLOSE.” Fuel flow into the aircraft should stop within a few seconds.

4. Release switches and fuel flow should resume.

# APPENDIX C

# AIRCRAFT: H-46 Series

5. Repeat the precheck process in step three above, this time holding the left “VALV CONT” switch to “PRI CLOSE.”

**CAUTION**

If fuel flow does not stop step 3 or 5 above, discontinue hot refueling operation immediately. System failure should be investigated and resolved before hot refueling can be accomplished.

6. Release switches and refuel aircraft until fuel flow into the aircraft stops and the fuel quantity gauge on the ground refueling panel indicates the tanks are full.

**SPECIAL NOTES — AIRCRAFT FUEL SYSTEM**

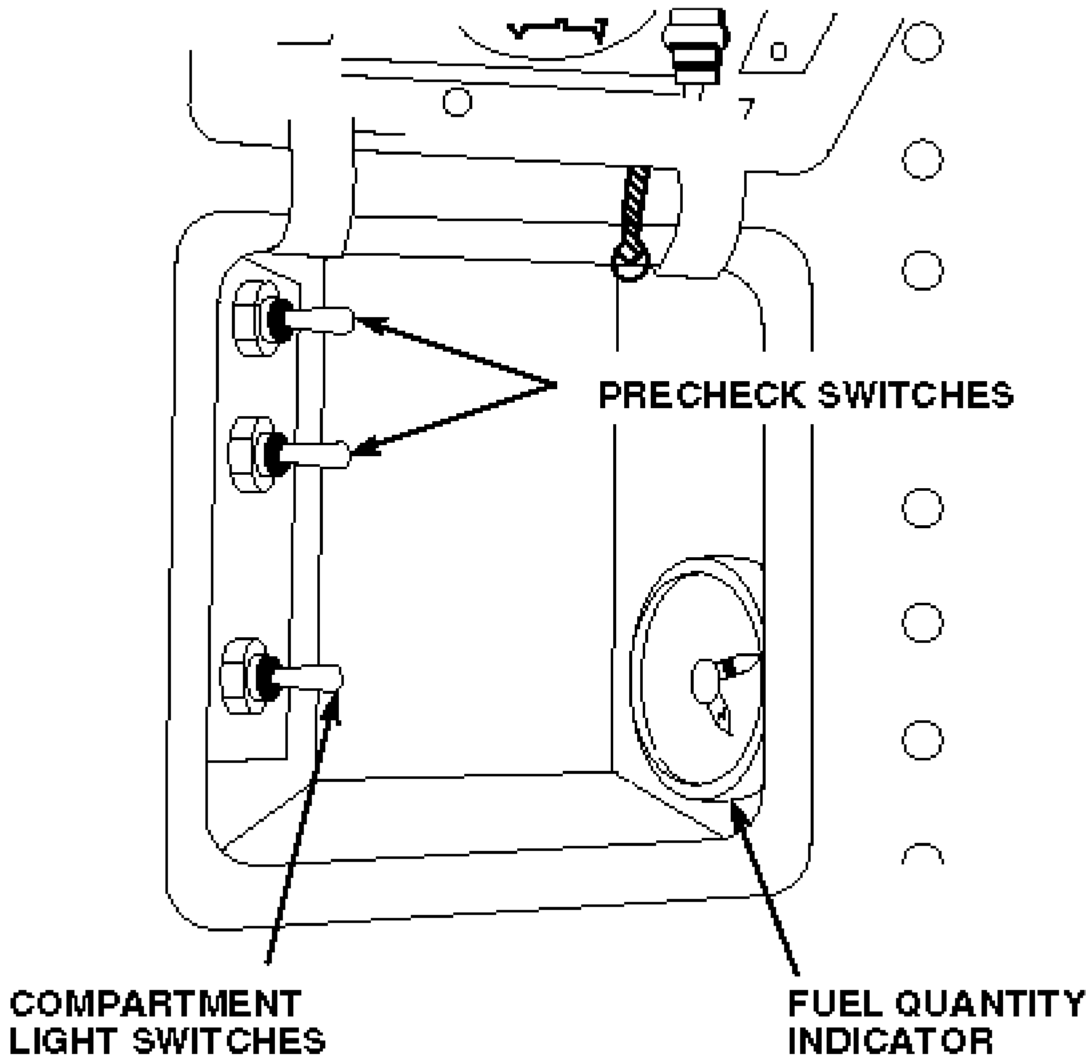
1. Under normal conditions, all air being displaced by fuel in the tanks exits the aircraft through the common “Fuel System Vent Ports,” which are located on each side of aircraft.

2. If any high-level shut-off valves fail to operate correctly, fuel may spill from one of the “Fuel System Vent Ports.” In addition, the fuel tanks, which are located in the Stubwings, may rupture and spill fuel

## APPENDIX C

## AIRCRAFT: H-46 Series

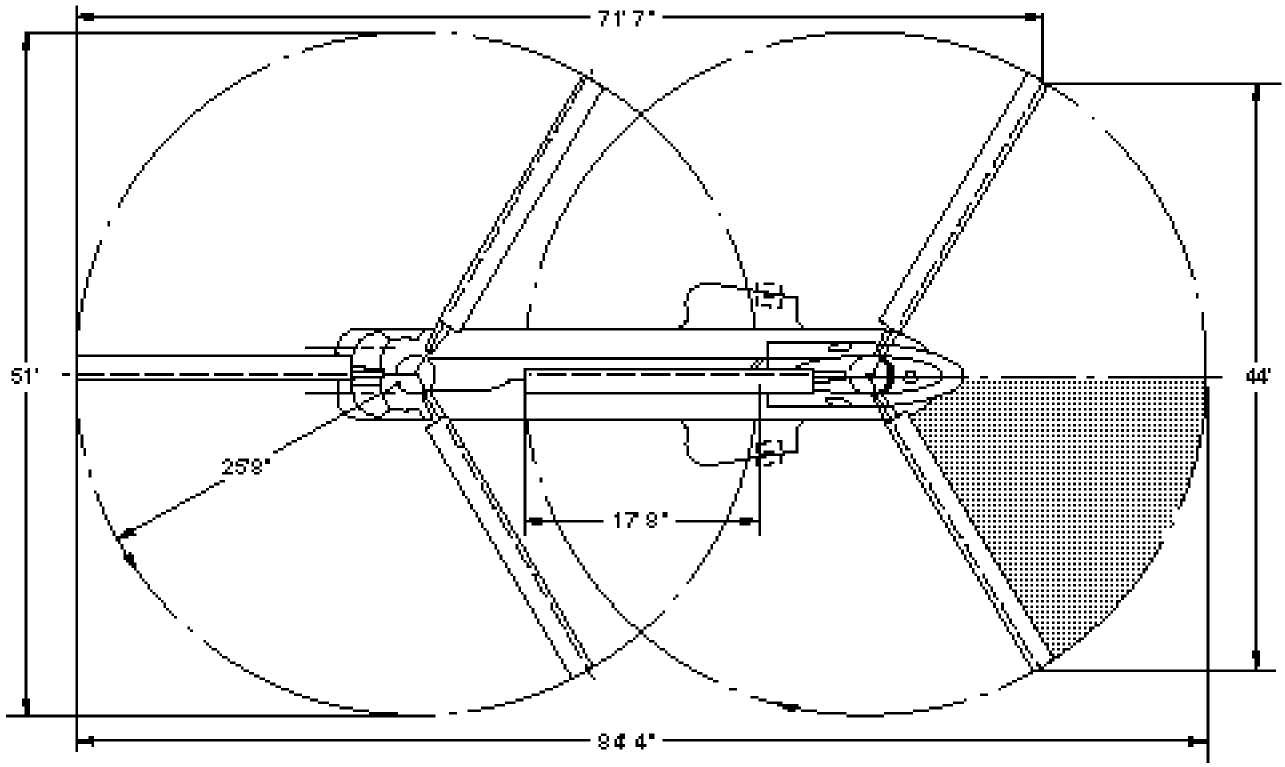
**GROUND REFUELING PANEL**

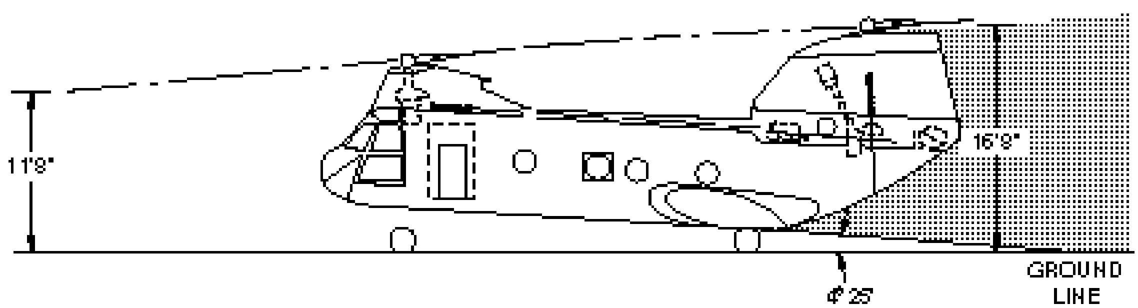


# APPENDIX C

## AIRCRAFT: H-46 Series

### PERSONNEL DANGER ZONES

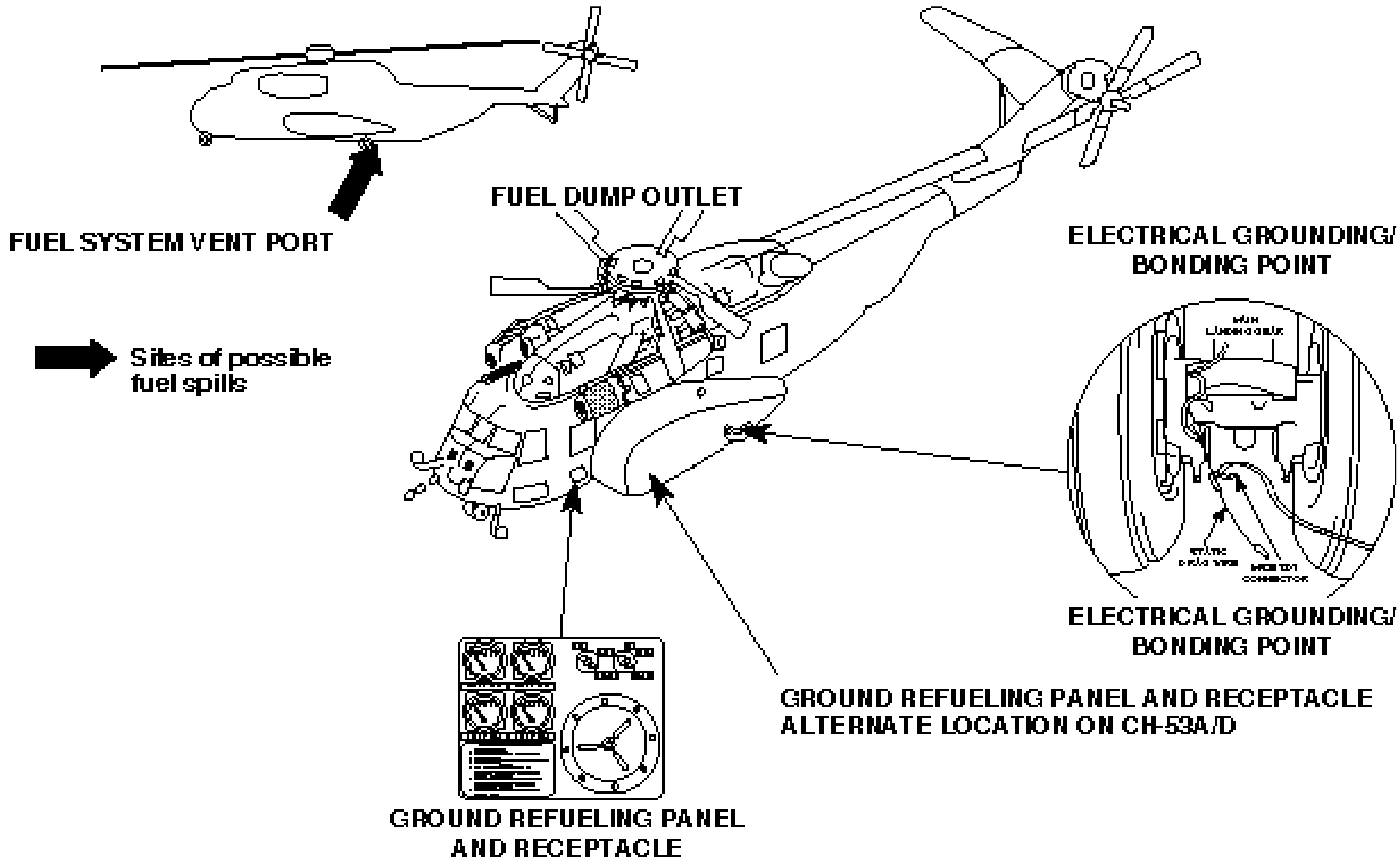


APPENDIX C

AIRCRAFT: H-53 Series

AIRCRAFT CONFIGURATION



# APPENDIX C

# AIRCRAFT: H-53 Series

## TABLES OF FUEL CAPACITIES

**MH-53E**

| **Tank** | | **Gallons** |
|---|---|---|
| Internal | No. 1 | 914.6 |
| | No. 2 | 1,383.2 |
| | No. 3 | 914.6 |
| | Total | 3,212.4 |

**CH-53E**

| **Tank** | | **Gallons** |
|---|---|---|
| Internal | No. 1 | 300 |
| | No. 2 | 377 |
| | No. 3 | 300 |
| | Total | 977 |
| External Aux Tanks (Each) | | 650 |
| Total | With 2 Aux Tanks | 2,277 |

**CH-53A/D**

| **Tank** | | **Gallons** |
|---|---|---|
| Internal | Left | 319 |
| | Right | 319 |
| | Total | 638 |
| External Aux Tanks (Each) | | 650 |
| Total | With 2 Aux Tanks | 1,938 |

# APPENDIX C

# AIRCRAFT: H-53 Series

## AIRCRAFT CHARACTERISTICS

**CH-53E, MH-53E**

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Fuselage Width (With Aux Tanks) | 14 ft | Maximum Gross Weight — 73,500 lbs |
| Length | 99 ft 0.5 in | Maximum Footprint — 135 psi |
| Height | 28 ft 0.5 in | |

**CH-53A/D**

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Fuselage Width (With Aux Tanks) | 24 ft | Maximum Gross Weight — 42,000 lbs |
| Length | 88 ft 6 in | Maximum Footprint — 135 psi |
| Height | 24 ft 11 in | |

## H-53 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the H-53 aircraft, primarily the operation of the "precheck" system. In addition to these specialized procedures, the applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

1. Open Ground Refueling Panel access door.

2. Remove receptacle cap, attach refueling nozzle, open nozzle to the fully open and locked position, and initiate fuel flow.

3. Exercise the Precheck system. On A and D models, simultaneously turn both precheck valves on the Ground Refueling Panel to "CLOSED" position. Fuel flow into the aircraft should stop within 10 seconds. On the CH-53E and MH-53E, turn the precheck valve labeled "PRI" to the "CLOSED" position and observe that fuel flow stops, then return the valve to the "OPEN" position. Repeat the last step, this time turning the precheck valve labeled SEC" to the "CLOSED" position.

**WARNING**

Flow of fuel while precheck valve(s) are in closed position(s) indicates a failed shutoff valve. Stop refueling immediately. System failure should be investigated and resolved before hot refueling can be accomplished.

# APPENDIX C

# AIRCRAFT: H-53 Series

4. Place precheck valves on Ground Refueling Panel in the “OPEN” positions and refuel aircraft.

5. Monitor the “Tank Pressure Indicators” on the Ground Refueling Panel.

**CAUTION**

If any tank pressure indicator rises above 1.5 psi, stop refueling immediately. Blockage in vent system should be investigated and corrected prior to refueling.

6. Continue fueling until fuel flow stops automatically.

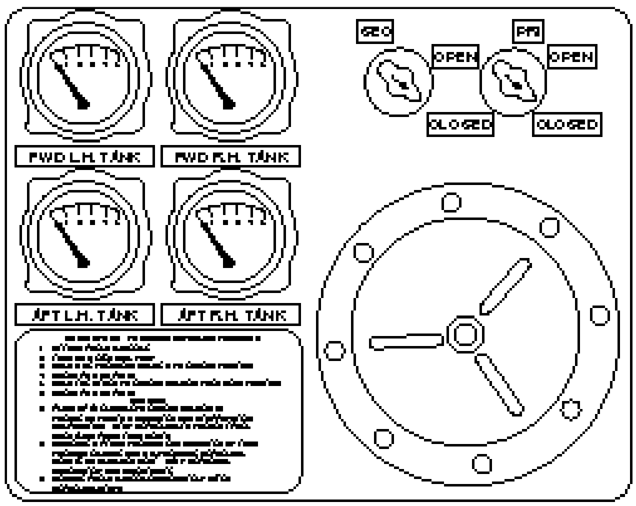
**SPECIAL NOTES — AIRCRAFT FUEL SYSTEM**

1. Under normal conditions, all air being displaced by fuel in the tanks exits the aircraft through the common “Fuel System Vent Ports,” which are located on the bottom of the aircraft's fuselage.
2. If any high-level shut-off valves fail to operate correctly, fuel may spill from one of the “Fuel System Vent Ports.” In addition, the fuel tanks may rupture and spill fuel.
3. The A and D model aircraft can be fitted with internal range extension tanks. Special procedures should be followed by the aircrew in order to refuel these tanks.

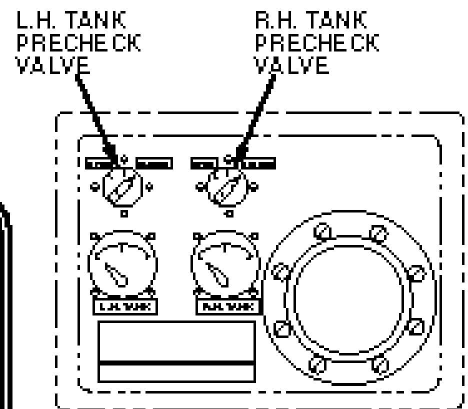
# APPENDIX C

# AIRCRAFT: H-53 Series

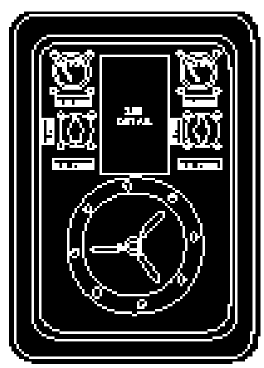
## GROUND REFUELING PANEL




**GROUND REFUELING PANEL
CH-53E and MH-53-E**




GROUND REFUELING PANEL
CH-53A/D

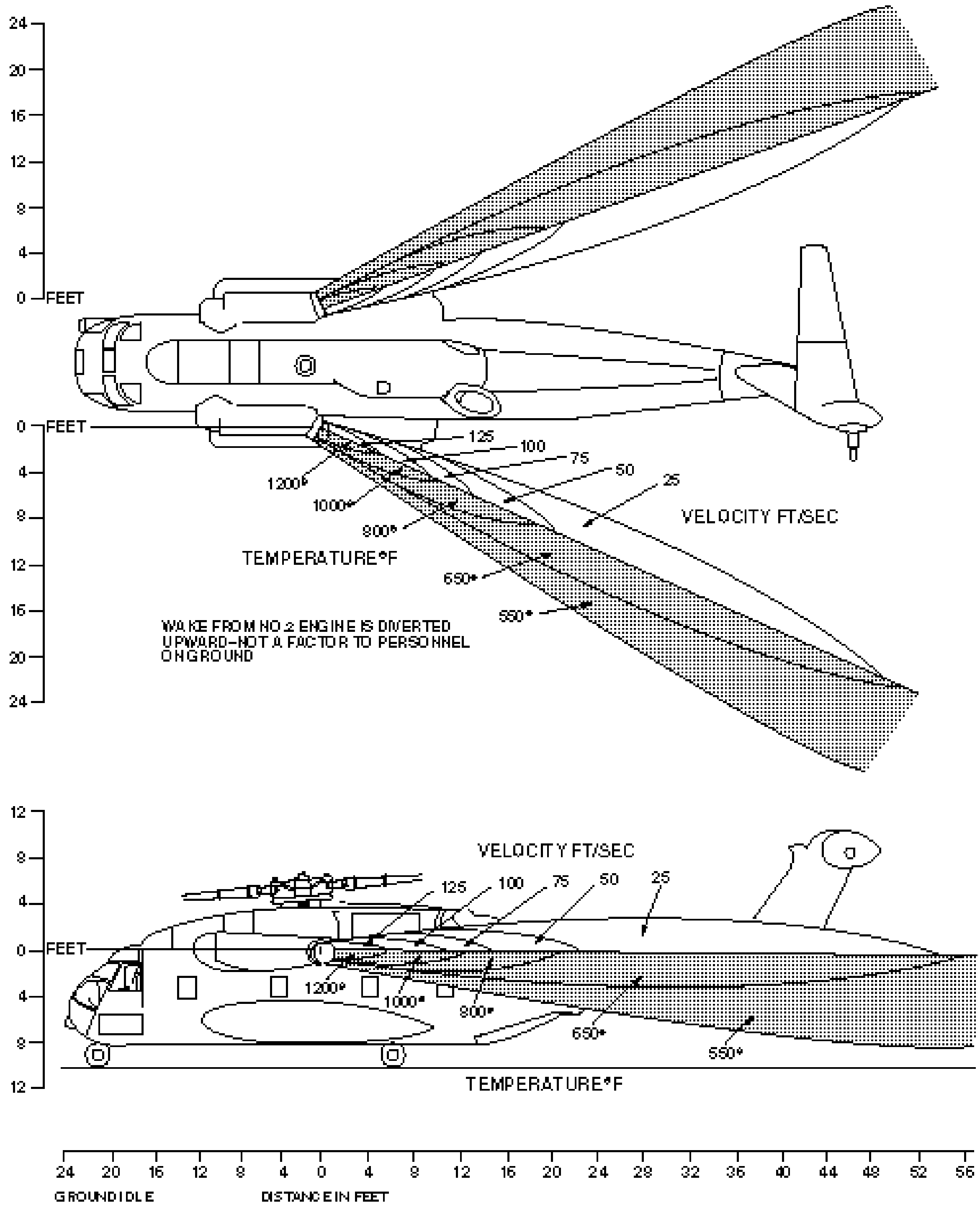


ALTERNATE GROUND REFUELING PANEL
CH-53A/D

# APPENDIX C

## AIRCRAFT: H-53 Series

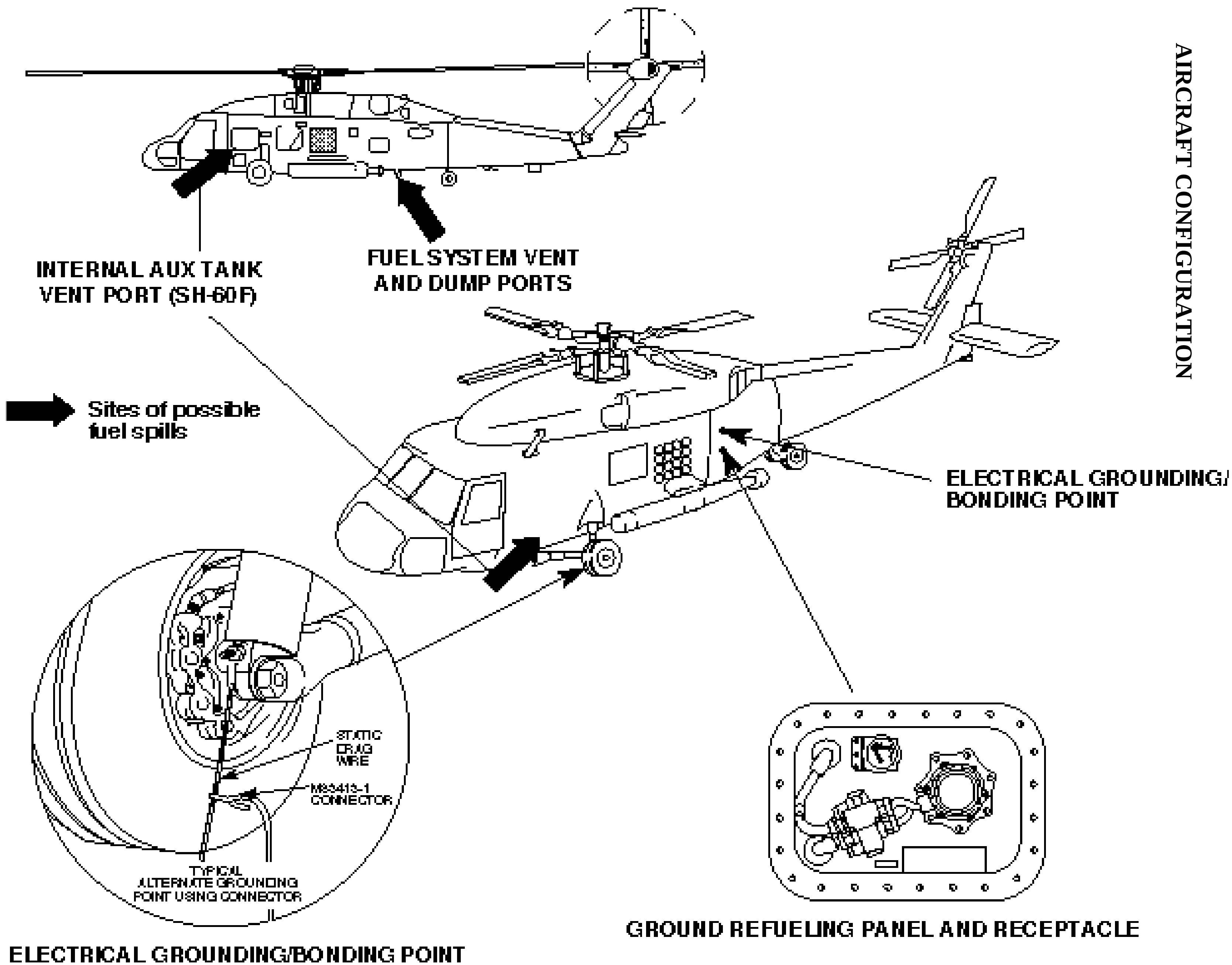
### PERSONNEL DANGER ZONES



## APPENDIX C

## AIRCRAFT: H-60 Series

### AIRCRAFT CONFIGURATION



# APPENDIX C

# AIRCRAFT: H-60 Series

## TABLE OF FUEL CAPACITIES

| Tank | | Gallons |
|---|---|---|
| Main | | 590 |
| External Aux | Left | 120 |
| | Right | 120 |
| Internal Aux (H/SH-60F only) | | 105 |
| Total Main + External Aux | | 830 |
| Total H/SH-60 | | 935 |

## AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Fuselage Width (With Aux Tanks) | 7 ft 9 in | Maximum Gross Weight — 22,000 lbs |
| Length | 64 ft 10 in | Maximum Footprint — 90 psi |
| Height | 17 ft | |

## H/SH-60 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the H/SH-60 aircraft, primarily the operation of the “precheck” system. In addition to these specialized procedures, the applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

1. Open Ground Refueling Panel access door.

2. Remove receptacle cap, attach refueling nozzle, open nozzle to the fully open and locked position, and intiate fuel flow.

3. Monitor the “Tank Pressure Indicator” on the Ground Refueling Panel.

**CAUTION**

If tank pressure indicator enters the red band, stop refueling immediately. Blockage in vent system should be investigated and corrected prior to refueling.

4. Hold the “OUTBOARD PRECHECK VALVE” in the “PRECHECK” position. Fuel flow should stop within 6 seconds.

# APPENDIX C

# AIRCRAFT: H-60 Series

5. Release the "OUTBOARD PRECHECK VALVE" and resume fuel flow.

6. Repeat the precheck process in step 4 above, this time holding the "INBOARD PRECHECK VALVE" in the "PRECHECK" position. Again fuel flow should stop within 6 seconds.

**CAUTION**

If fuel flow does not stop, discontinue hot refueling operation immediately. System failure should be investigated and resolved before hot refueling can be accomplished.

7. Release precheck valves and refuel aircraft until fuel flow into the aircraft automatically stops indicating the aircraft's tanks are full.

**SPECIAL NOTES — AIRCRAFT FUEL SYSTEM**

1. Under normal conditions, all air being displaced by fuel in the tanks exits the aircraft through the common "Fuel System Vent Ports," which are located on the bottom of the aircraft's fuselage. The H/SH-60F aircraft has an internal auxiliary tank that vents to an opening on the lower port side of the aircraft near the front. Each external auxiliary tank has a vent opening on its bottom approximately in the center.

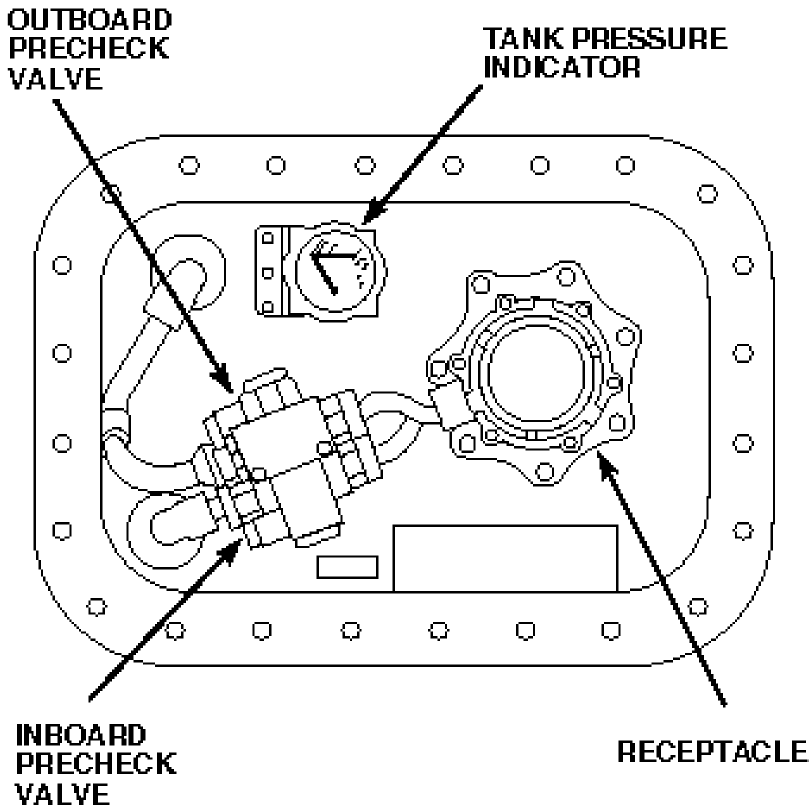
2. If any high-level shut-off valves fail to operate correctly, the tanks may rupture and/or fuel may spill from one of the "Fuel System Vent Ports."

3. The H/SH-60F aircraft has a second Tank Pressure Indicator, which displays the pressure in the Internal Auxiliary Tank.

# APPENDIX C

## AIRCRAFT: H-60 Series

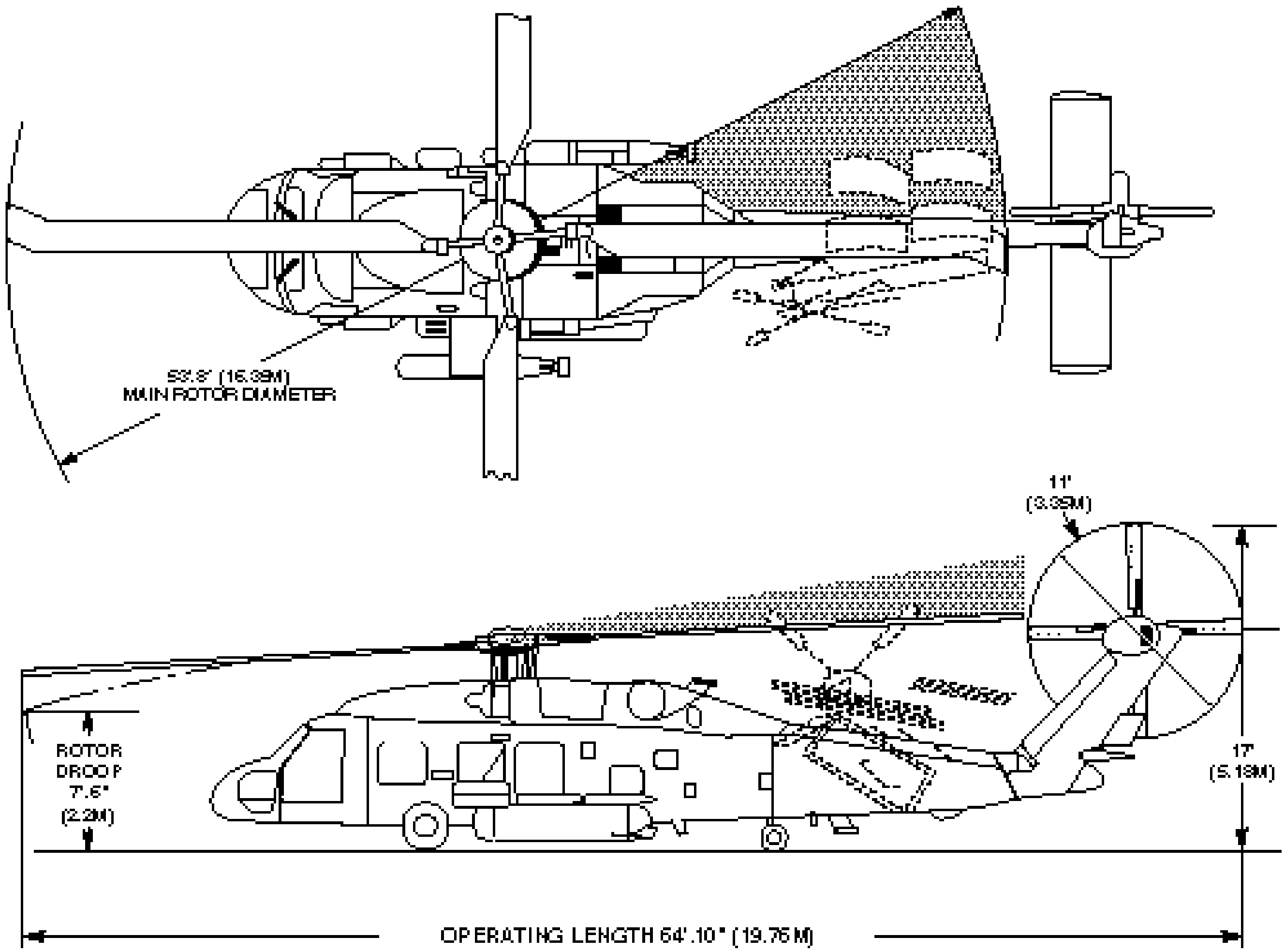
### GROUND REFUELING PANEL



# APPENDIX C

# AIRCRAFT: H-60 Series

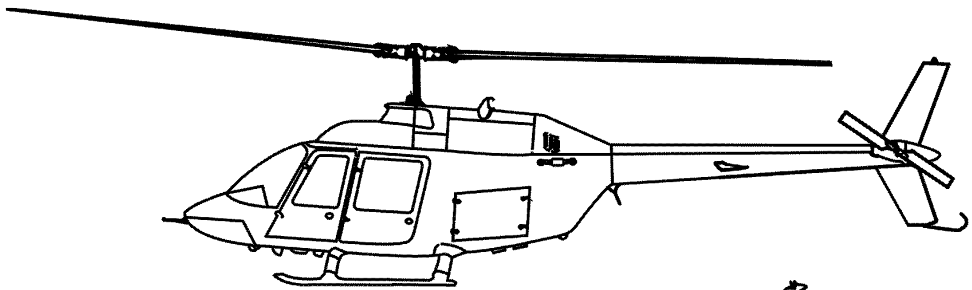
## PERSONNEL DANGER ZONES

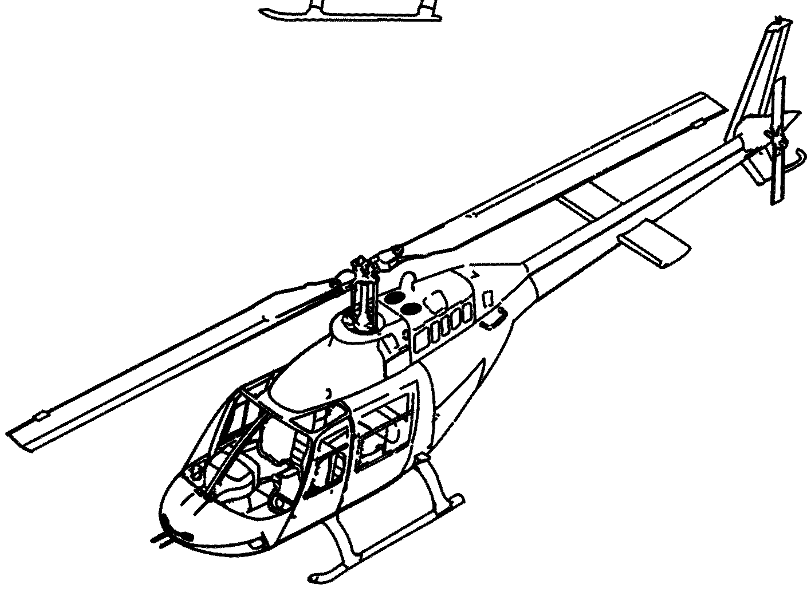


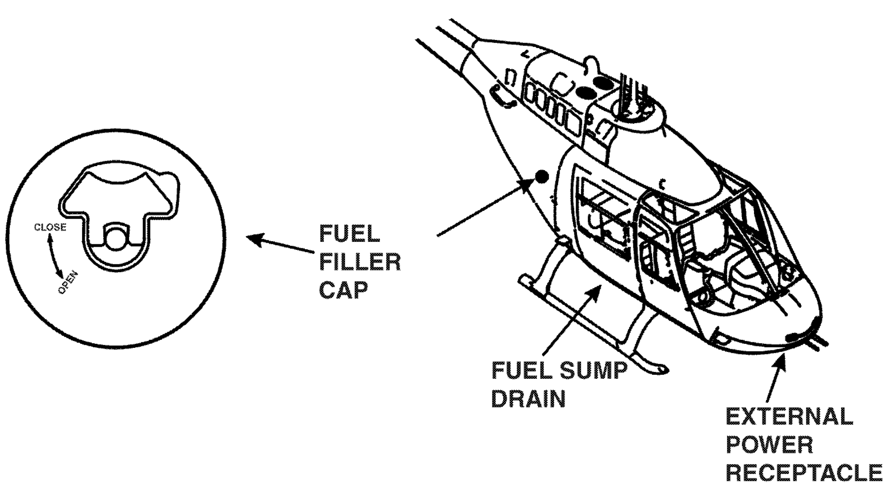
# APPENDIX C

# AIRCRAFT: TH-57

## AIRCRAFT CONFIGURATION



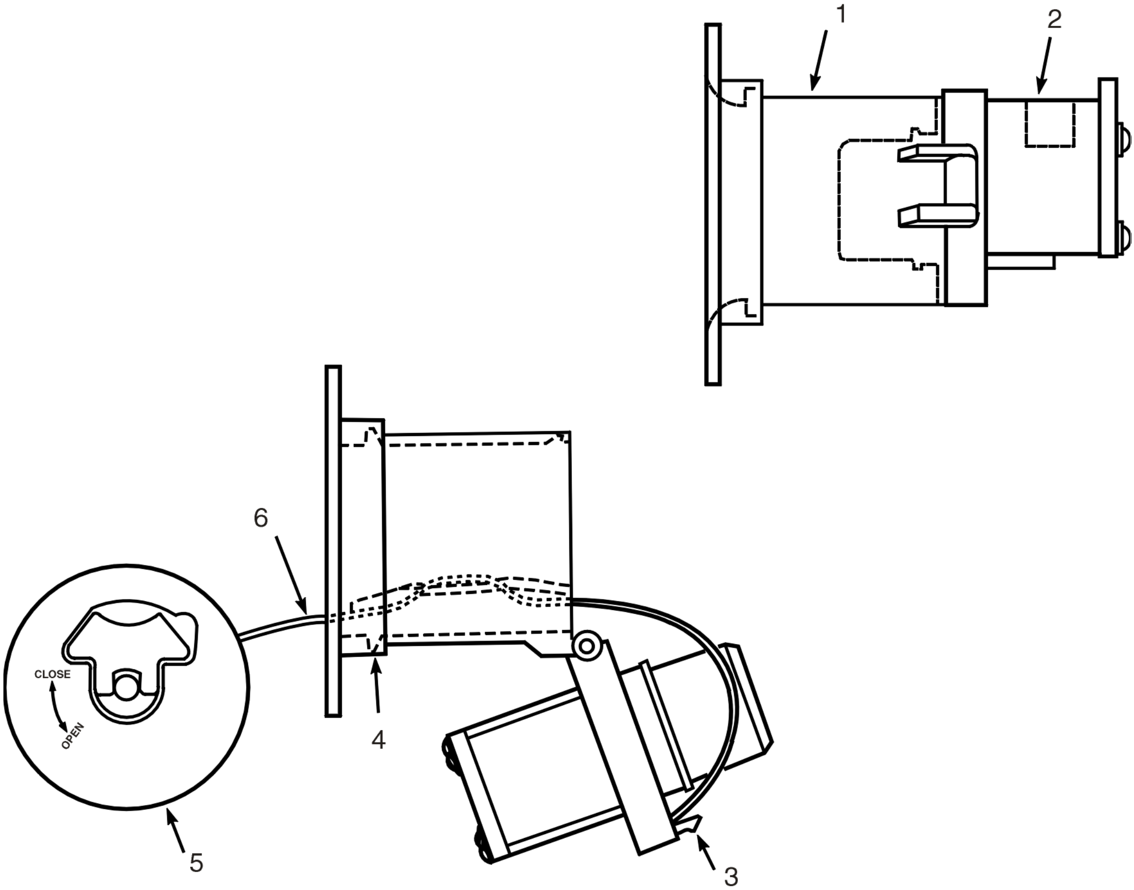




# APPENDIX C

## AIRCRAFT: TH-57

### FUEL SERVICING ASSEMBLY




1. Housing
2. Module
3. Latch
4. Tool, latch
5. Cap
6. Lanyard

# APPENDIX C

## AIRCRAFT: TH-57

### TABLE OF FUEL CAPACITIES

| Tank | Available |
|---|---|
| Normal Fuel Cell | 91 U.S. Gallons |
| Fuel Cell BUNO 161XXX | 76 U.S. Gallons |

### AIRCRAFT CHARACTERISTICS

| Aircraft Dimensions | | Aircraft Weight |
|---|---|---|
| Fuselage Width | 6 ft 3.5 in | Maximum Gross Weight — 3,200 lbs |
| Length | 39 ft 2.5 in | |
| Height | 11 ft 7.5 in | |

### TH-57 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the TH-57 aircraft. The applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

**WARNING**

Hot refueling of the TH-57 aircraft should only be accomplished using the 15-psi CCR nozzle. Hot refueling with overwing (gravity) refueling nozzles IS NOT authorized.

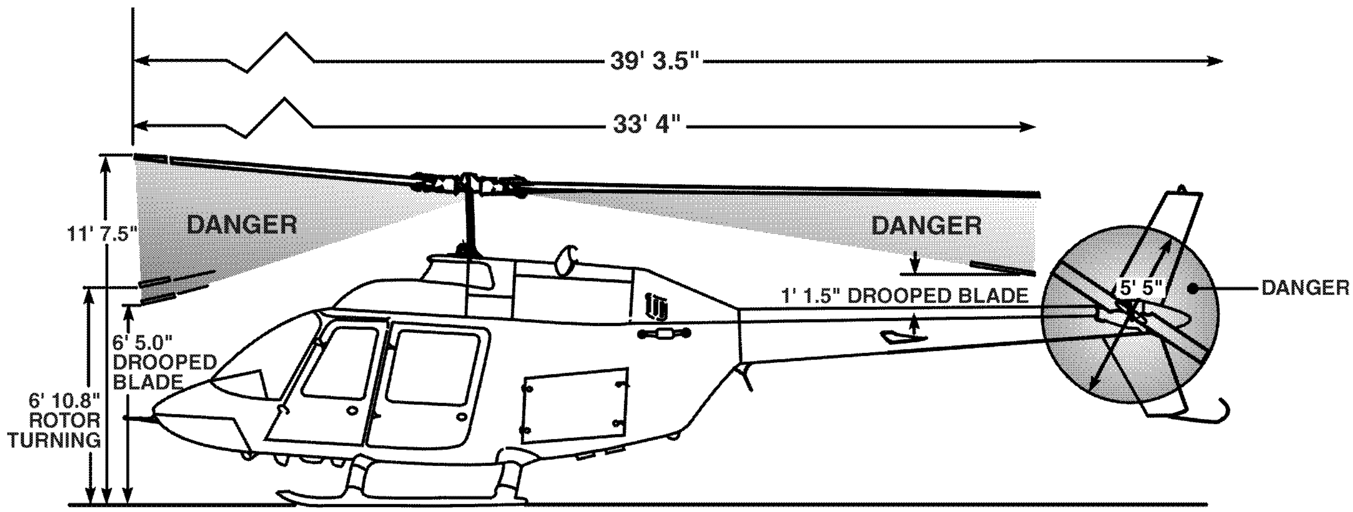
**Note**

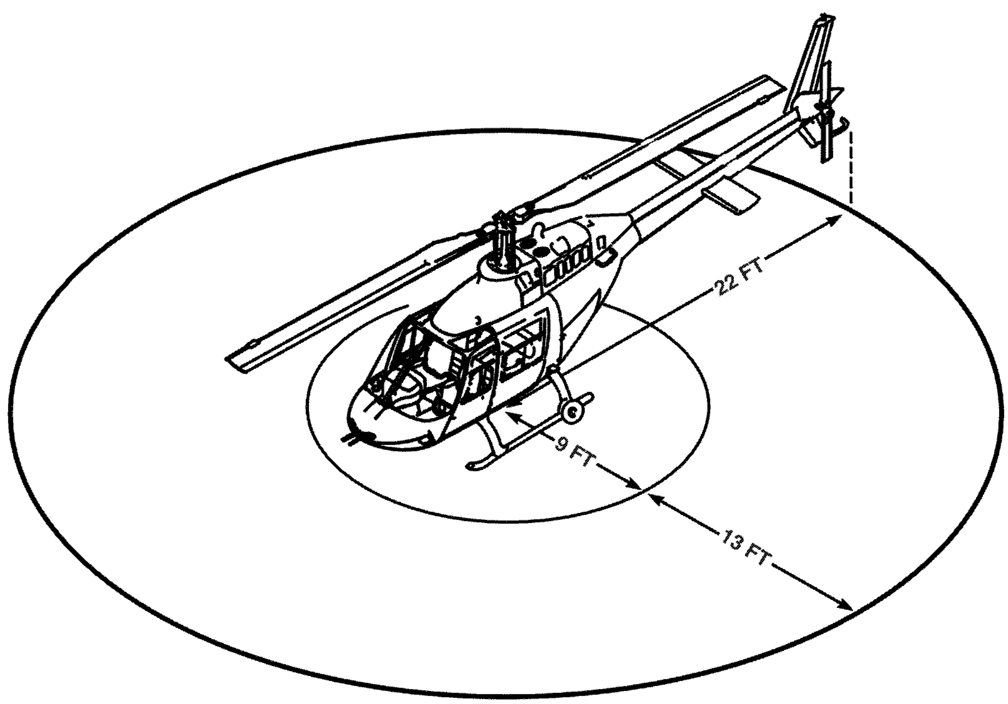
The TH-57 can only be refueled using either the overwing (gravity) refueling nozzle or the 15-psi closed circuit refueling (CCR) nozzle.

# APPENDIX C

## AIRCRAFT: TH-57

### PERSONNEL DANGER ZONES



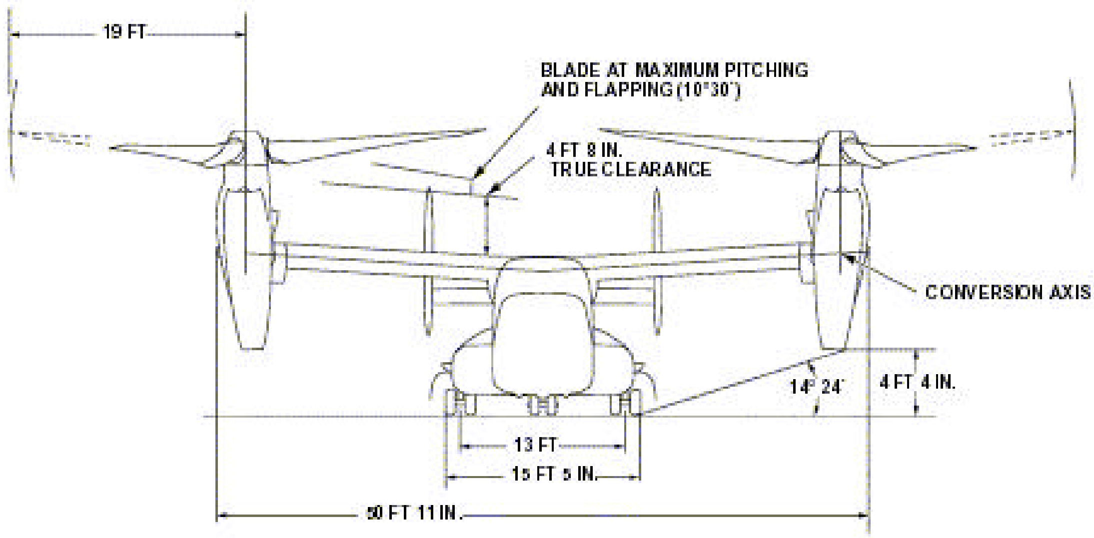




TURNING RADIUS

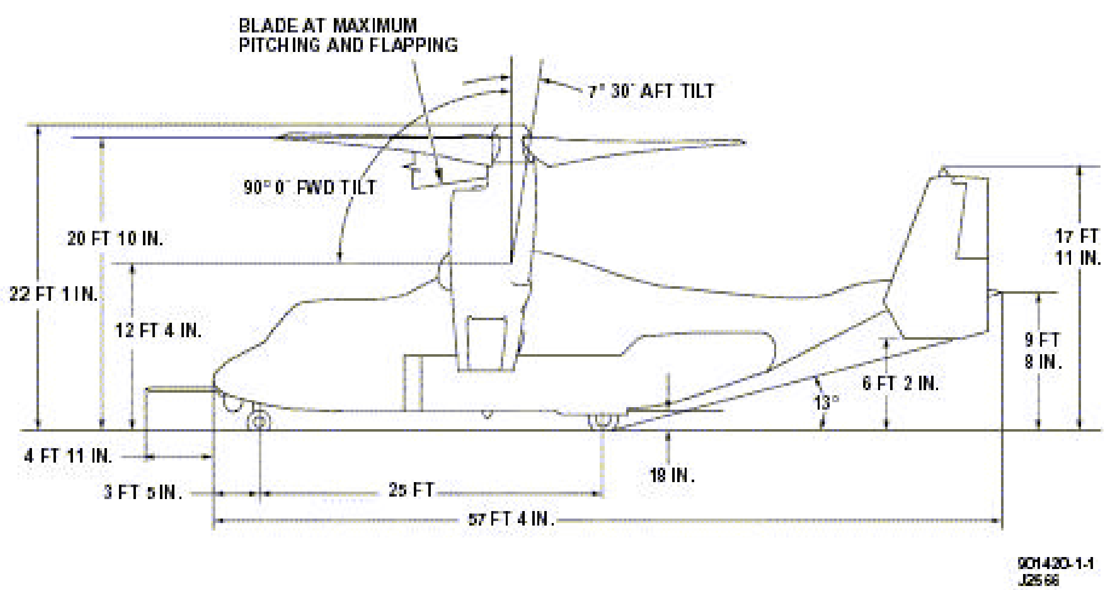
# APPENDIX C

# AIRCRAFT: MV-22

## AIRCRAFT DIMENSIONS




VIEW LOOKING AFT



# APPENDIX C

# AIRCRAFT: MV-22

## TABLE OF FUEL CAPACITIES

| Tank | Capacity |
|---|---|
| Feed | 88.2 U.S. Gallons |
| Sponson | 478 U.S. Gallons |
| Aft (right) Sponson | 316 U.S. Gallons |

## AIRCRAFT CHARACTERISTICS

### Dimensions

| Wings and Proprotors Extended | | Wings and Proprotors Stowed | |
|---|---|---|---|
| Width | | Width | 18 ft 5 in |
| Fuselage | 15 ft 5 in | Length | 63 ft |
| Wings | 50 ft 11 in (Engine to Engine)<br>88 ft 11 in (Outer edge of proprotor arcs) | Height | 18 ft 3 in |
| Length | 57 ft 4 in<br>(62 ft 3 in including refueling boom) | | |
| Height | 22 ft 1 in (Engines in vertical position) | | |

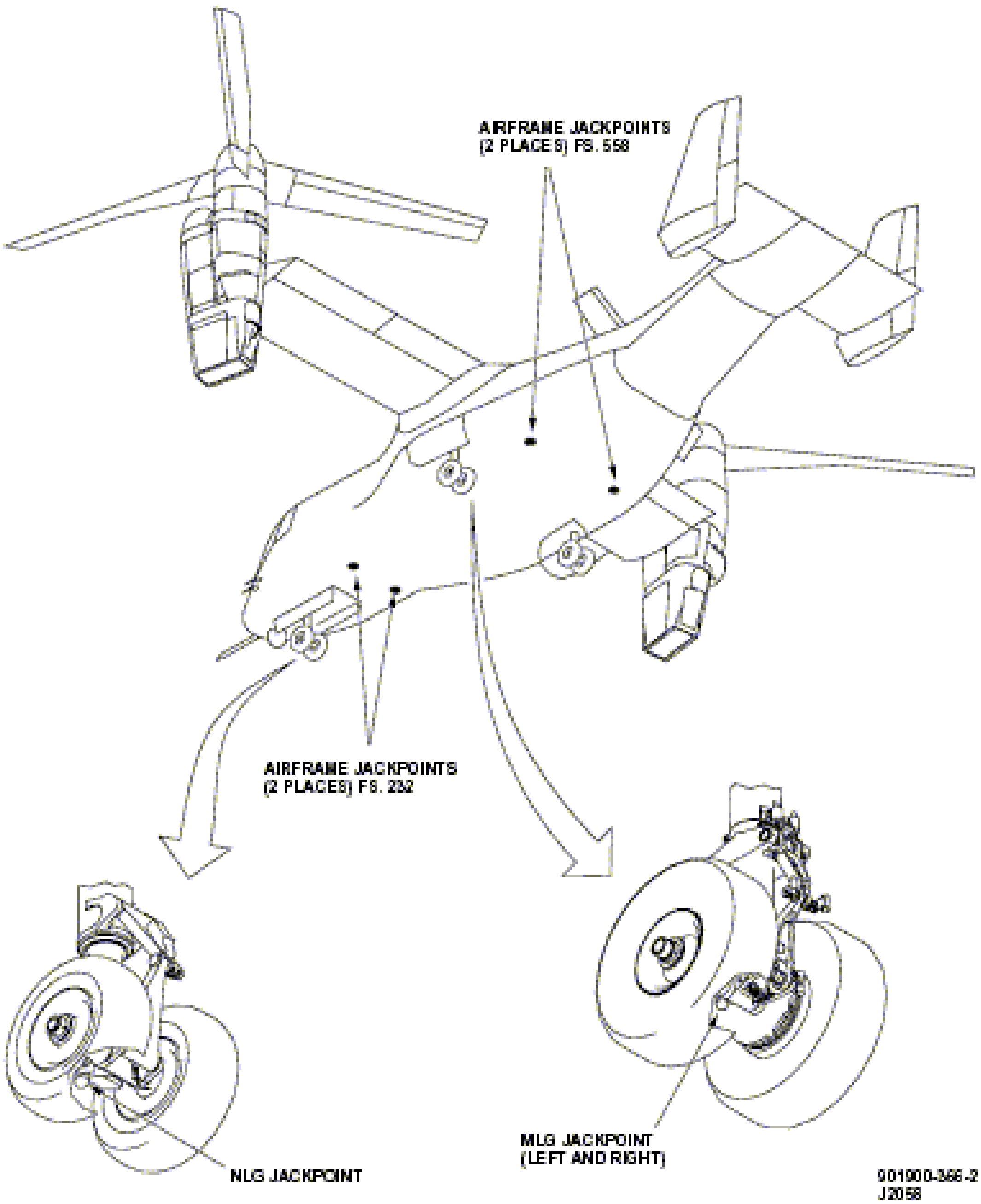
### Max Gross Weight

| | |
|---|---|
| VTOL | 52,600 lbs |
| STOL | 57,000 lbs |
| Self-deployment mission (smooth field conditions) | 60,500 lbs |

# APPENDIX C

# AIRCRAFT: MV-22

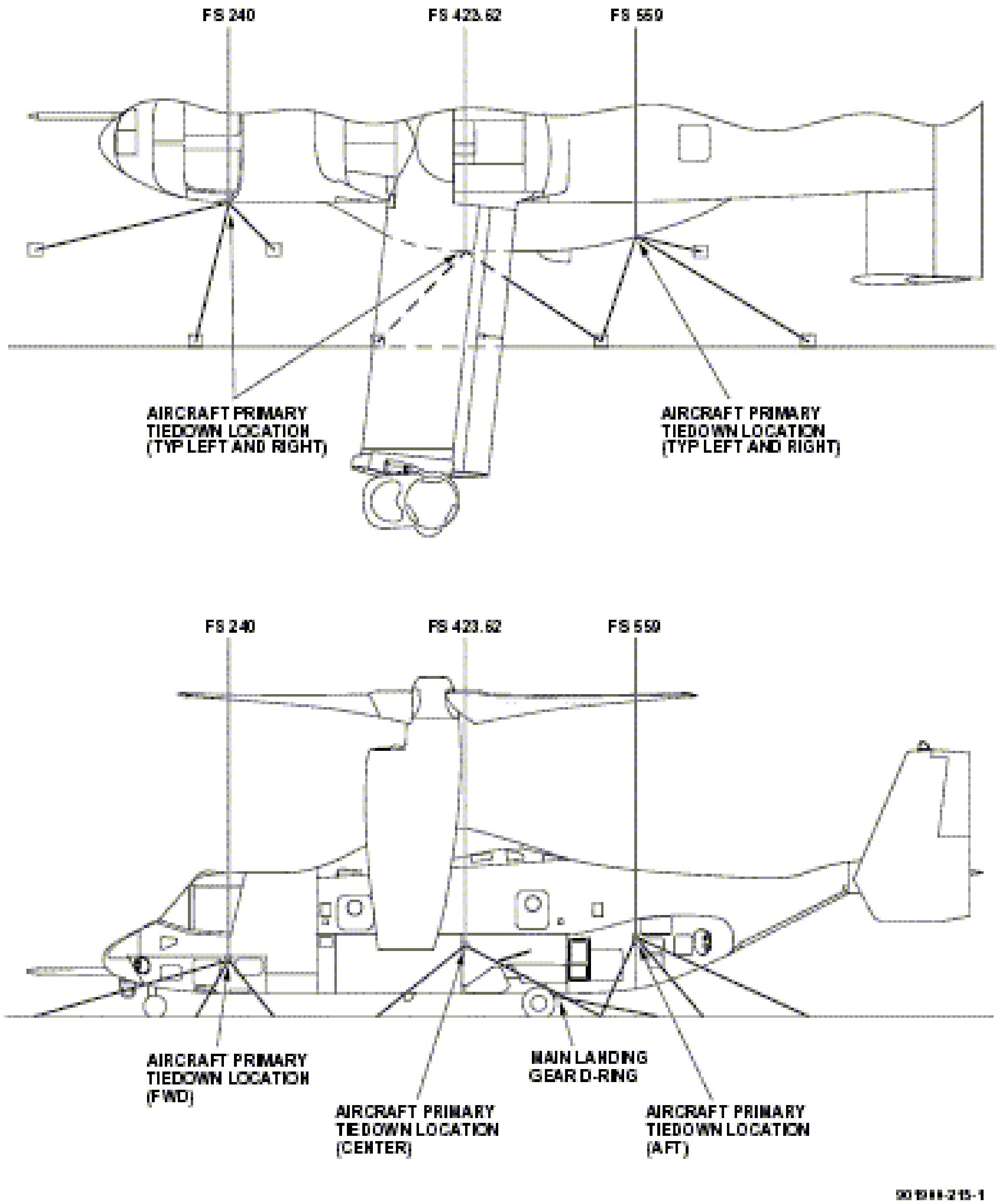
## AIRCRAFT CHARACTERISTICS (1 OF 3)



# APPENDIX C

# AIRCRAFT: MV-22

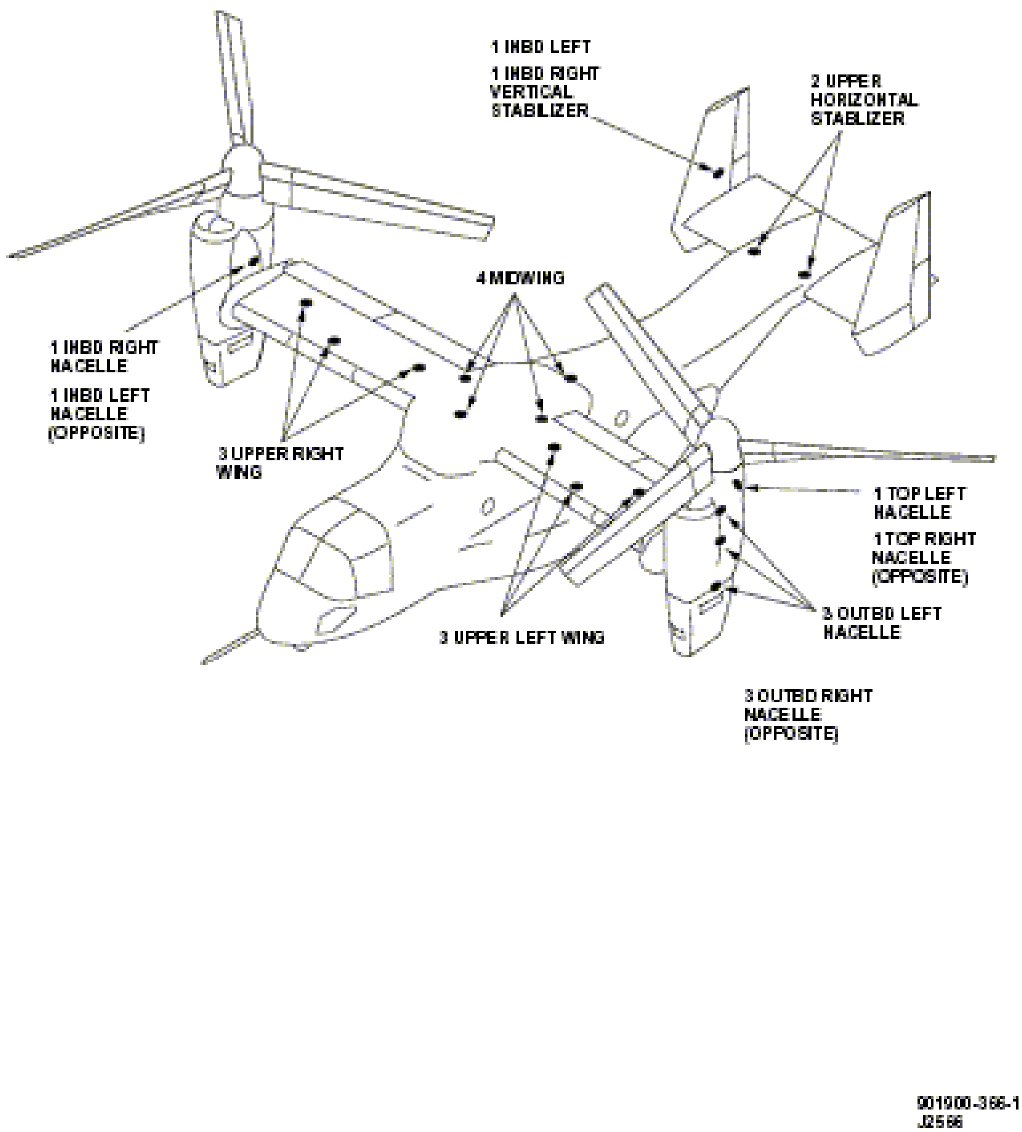
## AIRCRAFT CHARACTERISTICS (2 OF 3)



# APPENDIX C

# AIRCRAFT: MV-22

## AIRCRAFT CHARACTERISTICS (3 OF 3)



# APPENDIX C

# AIRCRAFT: MV-22

## MV-22 REFUELING PROCEDURES

The following procedures cover only those refueling procedures unique to the TH-57 aircraft. The applicable, basic refueling procedures contained in Chapter 6, 12 or 18 of the Aircraft Refueling NATOPS Manual, NAVAIR 00-80T-109, should be followed.

**Cold Pressure Refueling.** Single point pressure fueling (and suction defueling) of all airframe fuel tanks is provided by the GRDP single point refuel/defuel adapter. The GRDP is located aft of the left main landing gear behind panel 7LS1. Electrical power for the fuel management units, fuel valves, and the GRDP is supplied from the 28 Vdc essential/battery bus. No external power is required for pressure refueling. Refueling is controlled by a push-button switch marked MODE SEL, and two TANK FILL SEL push-button switches marked WING AUX and RH AFT SPON. System status is displayed by indicator lights and a digital total fuel quantity indicator. The maximum refueling rate is approximately 300 gpm at 50 psi.

**CAUTION**

- Halt pressure fueling operations immediately and conduct an inspection of the internal wing for structural damage if feed tank fuel spillage from a vent, or loud/unusual noise accompanied by wing vibration is noticed.

- To prevent structural damage ensure that fueling pressure does not exceed 55 psi.

To pressure refuel the aircraft:

1. Fuel truck/ship bonding cable — Connect to aircraft
2. GRDP panel and SPR adapter panel — Open
3. SPR adapter — Remove fuel cap.
4. GRDP power switch — ON

**NOTE**

The TOTAL FUEL QUANTITY should display.

5. Panel lighting — Adjust as desired.
6. LAMP TEST — Press.

**NOTE**

All lights should illuminate in sequence.

7. Pressure refueling adapter/nozzle — Connect to aircraft
8. Open fueling nozzle valve.

## APPENDIX C

## AIRCRAFT: MV-22

9. Check that nozzle cannot be disconnected.

10. MODE SEL switch — Press and release until the PRESSURE FILL light illuminates (Wait two seconds for process to start)

11. Under TANK FILL — press SEL FILL WING AUX and/or FILL RH AFT SPON (if desired)

12. Fueling truck/ship station — Start refueling (Depress and hold deadman switch if equipped)

13. Verify under SYSTEM STATUS on GRDP that PRECHECK light is illuminated.

**NOTE**

Once fuel flow to the aircraft has begun, the FUEL FLOW indicator will illuminate, and the fuel system automatic PRECHECK function will begin.

14. Verify that the SYSTEM FAIL light is not illuminated. If the SYSTEM FAIL light is illuminated, stop the refueling process. If the PRECHECK has successfully completed, the aircraft will begin to take on fuel again.

**NOTE**

Twenty seconds or less after the PRECHECK light is illuminated, fuel flow will stop. The PRECHECK light will extinguish and the NORMAL light will illuminate.

15. Observe SYSTEM STATUS display.

**CAUTION**

Monitor the SYSTEM STATUS lights constantly during refueling. If the STOP REFUEL indicator illuminates, immediately turn off the pump (by releasing the Deadman Switch if equipped) and close the refuel adapter valve immediately. Failure to do so may cause fuel spillage resulting in aircraft damage and possible fire hazard.

16. Fuel aircraft until flow automatically stops or until desired fuel quantity is indicated on the GRDP.

17. Fuel nozzle — Close, disconnect, and install fuel cap.

18. Bonding wire — Remove.

19. GRDP PWR switch — OFF.

20. GRDP access panel and SPR adapter access panel — Close.

# APPENDIX C

## AIRCRAFT: MV-22

**Hot Pressure Refueling (Two Engines Operating and Proprotors Engaged).** Disembark **a**ll personnel (except pilots and necessary refueling personnel) from the aircraft and move at least 50 ft. away from aircraft during hot refueling operations. Hot refueling is accomplished in the same manner as normal refueling, with the following additions:

1. Hot brake check — Complete
2. Prior to entering fueling area; Weapons/ESM/ ECCM systems — DISARM/OFF.
3. Parking brake — Set
4. Searchlights/landing lights — OFF
5. Left ECL — START
6. All nonessential personnel — Disembark and move 50 ft. from aircraft.
7. Cockpit side windows — Closed
8. Ramp door — Open
9. Ramp — Level
10. Landing gear — Chocked
11. Aircraft — Grounded
12. EMCON — Select
13. Pitot heat — OFF
14. Transfer pump — SUCTION

**NOTE**

Leave electrical status unchanged during refueling.

15. Refuel aircraft using standard cold pressure refueling procedures.

**WARNING**

Ensure that refueling hose is kept well clear of the engine exhaust wake. Temperatures of up to 300 °F above ambient exists below the engines.

**CAUTION**

Immediately cease fueling if any of the following tank quantities are exceeded:

- Feed tanks — 620 lbs
- Forward sponson tanks — 3300 lbs
- Aft sponson tank — 2200 lbs

## APPENDIX C

## AIRCRAFT: MV-22

16. Refueling — Complete
17. EMCON — Deselect
18. Crew/passengers — Embark
19. Chocks/ground wire — Remove
20. ECLs — FLY.

**Cold Gravity Refueling.** The aircraft is gravity refueled through a filler cap on the left forward sponson fuel tank. Fuel from the left forward sponson is transferred to the remaining tanks by the left and right sponson transfer pumps. External or APU electrical power is required for operation of the transfer pumps.

**WARNING**

Gravity refueling with aircraft engines operating is not authorized.

1. External power unit or start APU — Apply electrical power to aircraft.

**CAUTION**

Ensure left and right avionics ram air exhaust covers and pitot static probe covers have been removed before applying electrical power.

2. Fuel truck/ship bonding cable — Connect to ground
3. Left sponson tank filler cap — Remove and insert refueling nozzle.
4. GRDP PWR switch — ON.

**NOTE**

The TOTAL FUEL QUANTITY should display.

5. Panel lighting — Adjust as desired.
6. LAMP TEST — Press.

**NOTE**

All lights should illuminate in sequence.

7. MODE SEL switch — Press and release until GRAVITY FILL light illuminates.
8. TANK FILL SEL switches — Press and release until desired FILL lights illuminate.
9. Fueling truck/ship station — Start refueling.
10. Tanks — Refuel slowly until all are full, or the desired fuel quantity displays on the GRDP.

## APPENDIX C

## AIRCRAFT: MV-22

**CAUTION**

Monitor fuel flow from the refuel nozzle during gravity refueling to ensure that the left forward sponson tank is not over filled.

11. Fueling truck/ship station — Stop.
12. Refuel nozzle — Remove, secure fuel tank cap, remove ground wire.
13. GRDP PWR switch — OFF.
14. GRDP access panel — Close.
15. APU or external power — OFF or disconnected.
16. Battery — OFF.

**Defueling.**

**CAUTION**

The APU or main engines cannot be running during defueling operations. The wing feed tanks will empty first causing APU or main engine flameout and subsequent loss of prime.

1. Verify that the aircraft has been properly grounded. If not, connect ground wire to deck and to one of the aircraft grounding points.

2. Prior to initiating defueling, open the drain valve in the subject tank vent climb /dive valve. If more than one gallon of fuel is drained from vent, stop draining and break siphon by either:

   a. Vent the top of the sponson tank by loosening the gravity fill cap (left forward sponson only) or a fuel quantity probe (right sponson forward or aft tanks) to allow outside air to ventilate the tank, or

   b. Apply bottled nitrogen (5 psig) to the cabin tank OBIGGS connection for five minutes and completely drain the affected vent system (repeat nitrogen pressurization procedure as required if more than one gallon is drained from the vent system) prior to proceeding with suction defueling the affected tank.

**CAUTION**

Defueling any of the sponson tanks with fuel trapped in the vent system may damage the fuel cells and/or cell supports.

3. Open GRDP access panel 7LS1 on the left aft sponson.

4. Connect suction defueling equipment to pressure refueling port below the GRDP.

## APPENDIX C

## AIRCRAFT: MV-22

5. Set GRDP PWR switch to ON.

6. Press LAMP TEST to ensure all lights illuminate.

7. Press and release MODE SEL switch until SUCTION DEFUEL light illuminates. Wait two seconds for process to start.

8. Activate defueling equipment to apply suction to the nozzle flange and open nozzle valve.

9. Verify total fuel quantity is decreasing and the FUEL FLOW indicator is lit on the GRDP.

10. Defueling is complete when no flow is evident on the GRDP and FUEL QTY indication stops decreasing.

11. Close the defueling nozzle valve.

12. Press and release MODE SEL switch until STANDBY light illuminates.

13. Deactivate defueling equipment and disconnect from aircraft.

14. Turn OFF the GRDP by depressing the PWR switch.

15. Close the GRDP access panel.

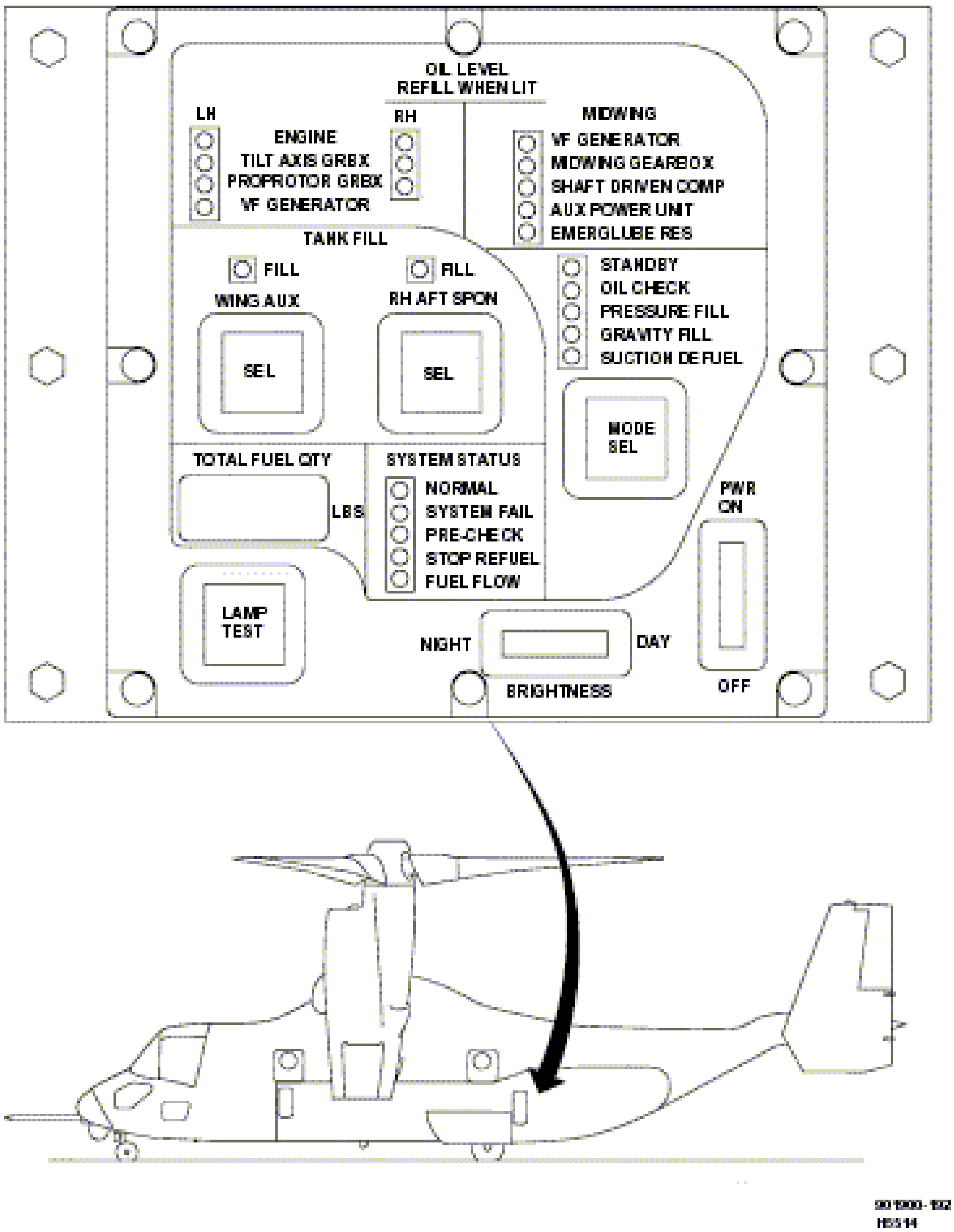
16. If a fuel cell is to be opened, open the appropriate tank drain valve to completely empty the tank.

17. Remove ground wire if aircraft is to be moved.

# APPENDIX C

# AIRCRAFT: MV-22

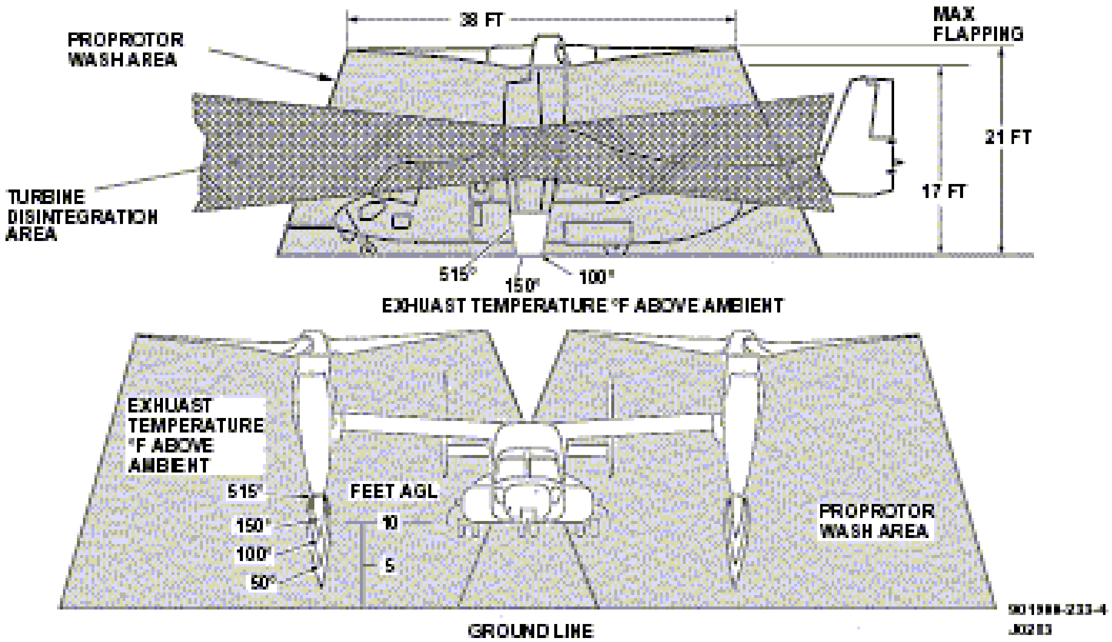
## GROUND REFUEL/DEFUEL PANEL

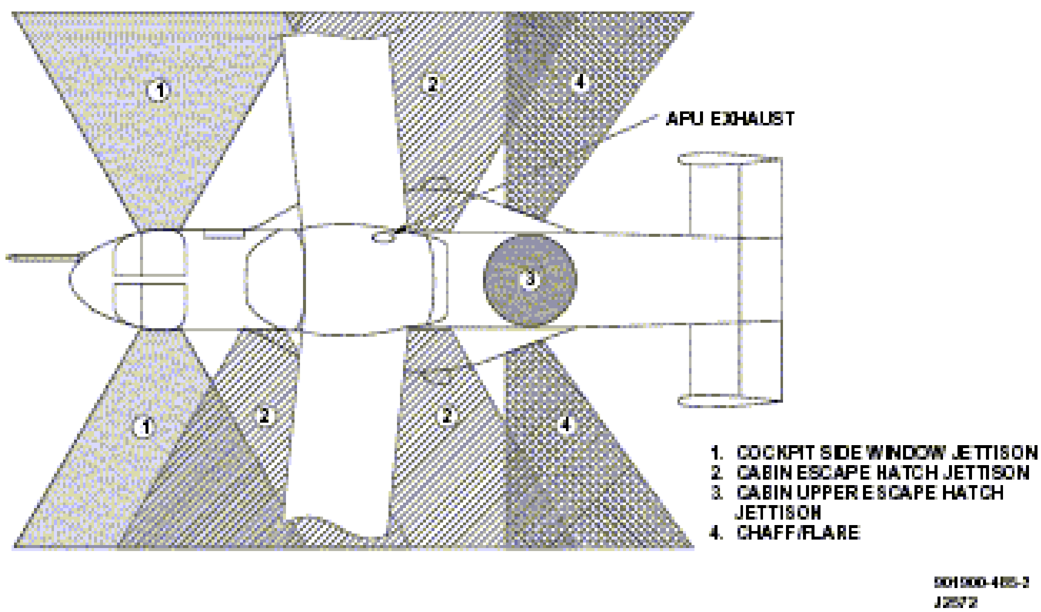


# APPENDIX C

# AIRCRAFT: MV-22

## DANGER AREAS

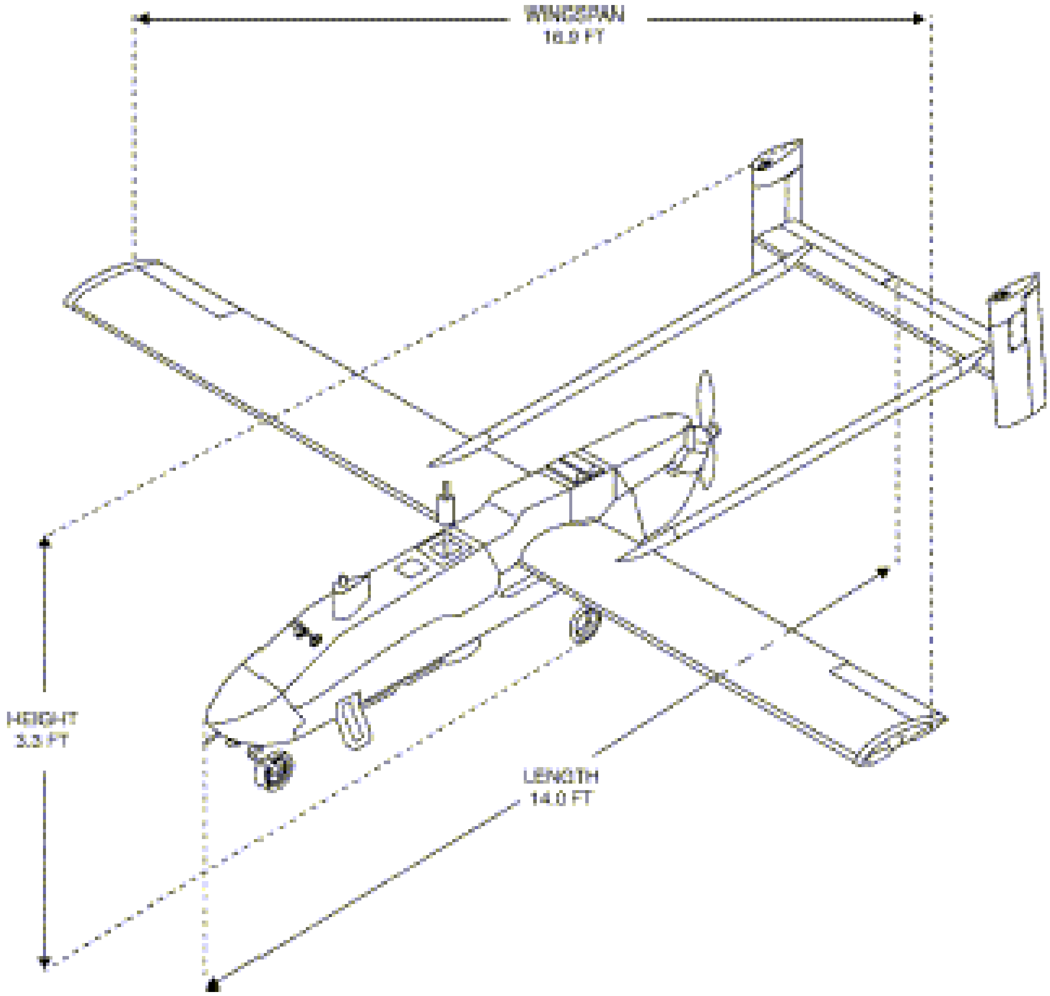


# APPENDIX C

# AIRCRAFT: RQ-2

## AIRCRAFT DIMENSIONS



# APPENDIX C

# AIRCRAFT: RQ-2

## AIRCRAFT CHARACTERISTICS

### Principal Dimensions

| | |
|---|---|
| Wing span | 16.9 feet |
| Length | 14.0 feet |
| Height | 3.3 feet |

### Fuel

AVGAS (94–100 Octane)

### Weights

| | |
|---|---|
| UAV (empty) | 308.6 pounds |
| Payload (max) | 75 pounds |
| Fuel (full tank is 44 liters) | 68.3 pounds |
| Max takeoff | 451.9 pounds |

# APPENDIX C

# AIRCRAFT: RQ-8

## TEST AIRCRAFT DIMENSIONS/DATA

| Air Vehicle | Specification |
|---|---|
| Rotor Disk Area | 594.5 ft sq |
| Max Takeoff Weight | 2550 lbs |
| Empty Weight | 1457 lbs |
| Mission Fuel Load | 793 lbs |
| Payload Weight | 200 lbs |
| Horizontal Tail Area | 3.1 ft sq |
| Vertical Tail Area | 4.7 ft sq |
| Anti-Torque Disk Area | 14.2 ft sq |

**RQ-8 fuel**: The RQ-8 operates on JP-5 (NATO F-44), JP-8 (NATO F-34) or Jet A-1 (NATO F-35).

**RQ-8 refueling**: The RQ-8 can be refueled by pressure or gravity.

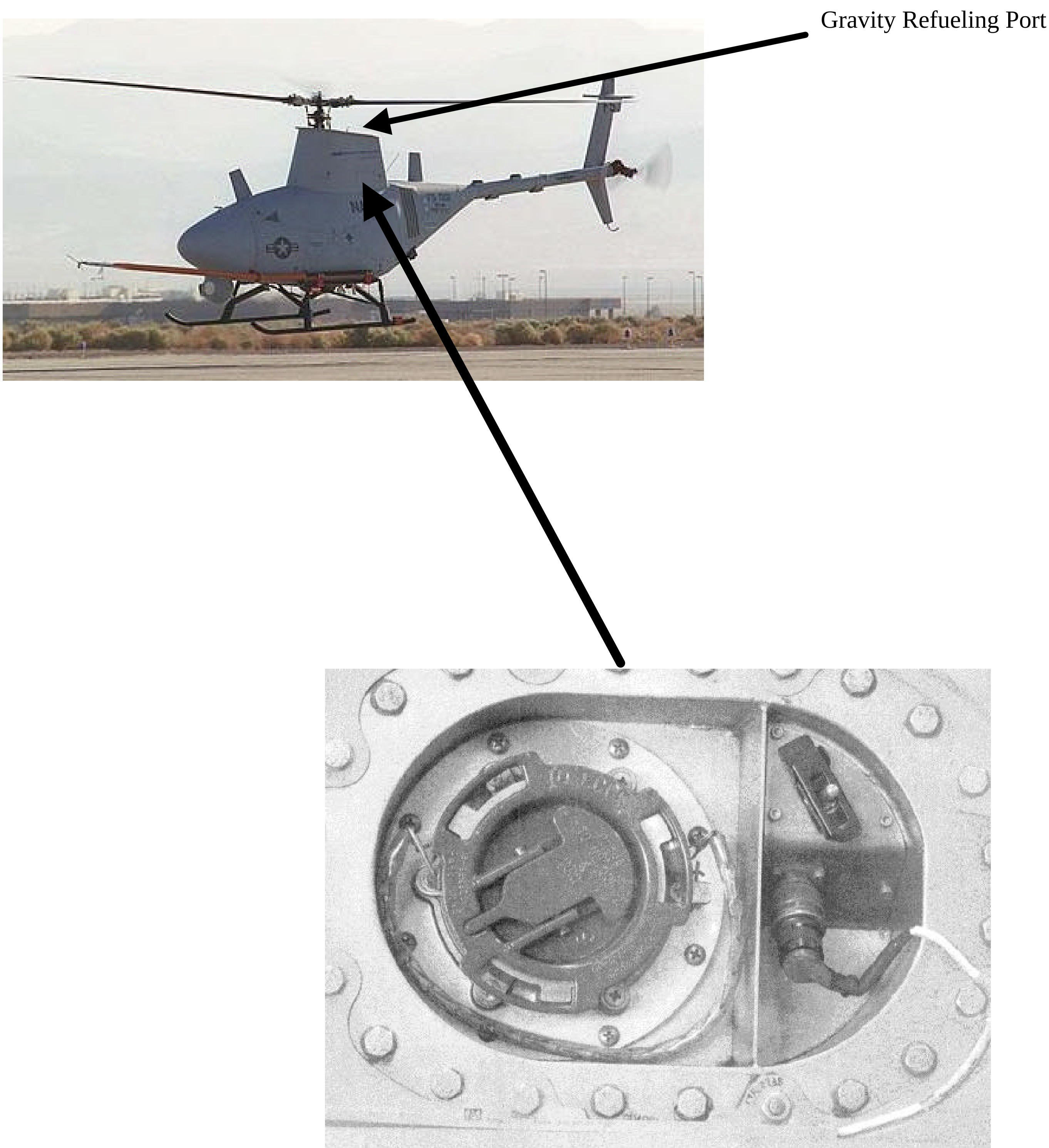
**Pressure refueling**: The RQ-8 fuel system incorporates a flow-limiting device between the single-point pressure refueling receptacle and the internal fuel bladder. The flow-limiting device ensures that fuel enters the RQ-8 at no more than 30 gallons per minute. The single-point pressure refueling receptacle is located on the port side of the aircraft located approximately 4.5 feet above deck level on the aircraft "sail" (see photo next page). Electrical power is required to pressure refuel the RQ-8.

**Gravity refueling**: The RQ-8's gravity refueling port is located on the top of the aircraft "sail" behind the rotor mast. To access the gravity refueling port, a maintenance platform or ladder is required.

# APPENDIX C

# AIRCRAFT: RQ-8

## REFUELING PROCEDURES




Pressure Refueling Panel

# APPENDIX C

## AIRCRAFT: RQ-8

**Pressure Fuel System Inspection** (to be accomplished daily prior to the first refueling evolution)

| Item | Who | Task | Verify/Record |
|---|---|---|---|
| 5.1.1 | ACC | Verify UAV is properly grounded. | ☐ |
| 5.1.2 | ACC | Remove left side engine bay panel. | ☐ |
| 5.1.3 | **ACC** | Inspect the upper fuel bladder vent tube that runs fwd of mast to left side of engine bay for:<br>a. Proper routing<br>b. Obstructions<br>c. Kinks<br>d. Fuel leaks. | ☐ |
| 5.1.4 | ACC | Open gravity fuel access door and inspect vent for any obstruction to the vent tube and vent tube port. | ☐ |
| 5.1.5 | ACC | Open pressure fuel access door and verify high-pressure switch connector properly connected. | ☐ |
| | | **NOTE**<br>**The pressure switch has three positions. The lower position is inactive and has no function. Center (Closed) and upper (Open) are the only functional sides of the three position switch.** | |
| 5.1.6 | ACC | Lift pressure switch cover and position switch to the “Closed” position. Close switch cover and verify switch goes to the “Open” position. | ☐ |

# APPENDIX C

# AIRCRAFT: RQ-8

**Pressure Fueling Procedure**

| Item | Who | Task | Verify/Record |
|---|---|---|---|
| | | Verify fueling source supply is not greater than 60 psig. | |
| 5.2.1 | ACC | Verify UAV and fuel source are properly grounded. | ☐ |
| 5.2.2 | ACC | Verify fuel source is properly grounded. | ☐ |
| 5.2.3 | ACC | Connect ground cable from fuel source point (fuel nozzle) to UAV. | ☐ |
| | | **WARNING** If Gravity Fuel Cap is not properly installed during Pressure Fueling, fuel spillage will occur from gravity fuel port. | |
| 5.2.4 | ACC | Verify gravity fuel cap is properly installed. | ☐ |
| 5.2.5 | ACC | Verify pressure fuel valve switch guard is down and switch is in the “Closed” position. | ☐ |
| 5.2.6 | ACC | Depress GCP pressure fueling circuit breaker. | ☐ |
| 5.2.7 | ACC | Unlatch and remove pressure fuel cap. | ☐ |
| 5.2.8 | ACC | Connect pressure fuel nozzle to UAV. | ☐ |
| | | **WARNING** With pressure fuel nozzle connected to UAV and fuel valve switched “Open” you will have immediate fuel flow into UAV. | |
| 5.2.9 | ACC | Position pressure fuel valve switch guard “Up” and switch to the “Open” position. Verify fuel flow. | ☐ |
| 5.2.10 | ACC | After approximately 30 seconds of fuel flow perform pre-check of shut-off system. Position pressure fuel valve switch to the “Closed” position. Fuel flow should stop. | ☐ |
| 5.2.11 | ACC | Re-position pressure fuel valve switch to the “Open” position. Verify fuel flow. | ☐ |
| 5.2.12 | ACC | Fuel flow stops automatically when fuel tank is full. | ☐ |
| 5.2.13 | ACC | Position pressure fuel valve switch guard “Down” and switch to the “Closed” position. | |
| 5.2.13 | ACC | Disconnect fueling nozzle and stow. | ☐ |
| 5.2.14 | ACC | Properly replace pressure filler cap. | ☐ |
| 5.2.15 | ACC | Pull pressure fueling circuit breaker. | ☐ |
| 5.2.16 | ACC | Disconnect ground cables as required. | ☐ |

# APPENDIX D

## GLOSSARY

D.1 Definitions

D.1.1 AFFF. The acronym for Aqueous Film Forming Foam, the Department of Defense standard firefighting agent for flammable and combustible liquid fires.

D.1.2 Adsorption. A separation method where one component is concentrated on the surface of a porous solid. Surfactants (surface active agents) are separated from jet fuel by adsorption on clay.

D.1.3 Ambient temperature. The air temperature surrounding a specific area.

D.1.4 API gravity. The petroleum industry's scale and method of measuring density of petroleum products.

D.1.5 Aviation gasoline (AVGAS). Specially blended gasolines used to power reciprocating piston aircraft engines.

D.1.6 Clay treater. A treating unit that utilizes a special clay (Fuller's earth) to remove surfactants from turbine fuel.

D.1.7 CMC. Commandant of the Marine Corps.

D.1.8 CNATRA. Chief of Naval Air Training.

D.1.9 CNO. Chief of Naval Operations.

D.1.10 Coalescence. The property of a filter cartridge to bring together very fine droplets of free and entrained water to form large droplets that are heavy enough to fall to the bottom of the filter/separator vessel.

D.1.11 Contaminants. Either foreign or native substances that may be present in fuel and which detract from fuel performance.

D.1.12 Cowling. Removable covering around engine sections.

D.1.13 Cyclone separator. A device that used the principle of centrifugal force to cause the contaminate in a fuel to settle to the bottom of the vessel without the use of filter media.

D.1.14 Density. The amount of mass (weight) in a unit volume of a material.

D.1.15 Differential pressure (Delta P). The measured difference in pressure between any two points, generally at the inlet and outlet of a filter or a filter/separator.

D.1.16 Disarming action. As applied to filter/separators, the rendering of the elements incapable of performing their designed functions; e.g., coalescer elements incapable of coalescing water and separator elements incapable of separating water from fuel.

D.1.17 Dissolved water. Water that is in solution in the fuel. This water is not free water and cannot be removed by conventional means.

D.1.18 Eductor.

D.1.18.1 A device placed in a hose line to proportion liquid foam or wetting agents into the fire stream.

D.1.18.2 An ejector that siphons water by creating a vacuum from the velocity of water passing through it.

D.1.19 Effluent. Stream of fluid at the outlet of a filter or filter/separator. This is the opposite of influent.

D.1.20 Empennage. Aircraft tail assembly including stabilizers, elevators, rudders, etc.

D.1.21 Emulsion. A dispersion of two dissimilar immiscible droplets in the continuous phase.

D.1.22 Entrained Water. Small droplets of free water in suspension that may make fuel appear hazy.

D.1.23 EOD. Explosive ordnance disposal.

D.1.24 ETA. Estimated time of arrival.

D.1.25 Exhaust. The part of the engine through which the exhaust gases are ejected.

D.1.26 Filter. A device to remove solid contaminants from fuel.

D.1.27 Filter membrane (Millipore) test. A standard test in which fuel is passed through a small filter membrane housed in a plastic holder. The cleanliness of the fuel can be determined by examining the membrane.

D.1.28 Filter/Separator. A mechanical device used to remove entrained particulate contaminants and free water from a fuel.

D.1.29 Fin. A fixed or adjustable airfoil for directional stability, such as a tail fin or a skid fin. A common name given the vertical stabilizer.

D.1.30 Fixed Base Operator (FBO). Common title for aviation fuel dealer at the airport.

D.1.31 Flaps. A movable airfoil attached to the trailing edge of the wing that improves the aerodynamic performance of the aircraft during takeoffs and landings.

D.1.32 Flash point. The lowest fuel temperature at which the vapor above the fuel will ignite.

D.1.33 Floating suction. A floating device used in a tank for drawing product from the upper level of the fuel.

D.1.34 Free water. Water in the fuel other than dissolved water. Free water may be in the form of droplets or haze suspended in the fuel (entrained water) and/or a water layer at the bottom of the container holding the fuel. Free water may also exist in the form of an emulsion which may be so finely dispersed as to be invisible to the naked eye.

D.1.35 Freezing point (fuel). The lowest fuel temperature at which there are no crystals.

D.1.36 Halogenated agent. An extinguishing agent composed of hydrocarbons in which one or more hydrogen atoms have been replaced by halogen atoms; the common halogen elements used are fluorine, chlorine, bromine, and iodine.

D.1.37 Hazardous Material. Any substance that, by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, or otherwise harmful, is likely to cause death or injury.

D.1.38 Hydrophilic. Water accepting or water wettable.

D.1.39 Immiscible. Liquids that are mutually insoluble. This is the opposite of miscible.

D.1.40 Influent. Stream of fluid at the inlet of a filter or filter/separator. This is the opposite of effluent.

D.1.41 Landing gear. The understructure that supports the weight of an aircraft when in contact with land. It usually contains a mechanism for reducing the shock of landing (also called undercarriage).

D.1.42 Longerons. The principal longitudinal structural members of the fuselage.

D.1.43 MarForLant/Pac/Res. Marine Forces Atlantic, Pacific, or Reserve.

D.1.44 Micron (Micrometer). A unit of linear measurement. One micron is equal to 0.000029 in. and approximately 25,400 microns equals 1 in. For example, the average human hair is about 100 microns in diameter.

D.1.45 Miscible. Liquids that are mutually soluble. This is the opposite of immiscible.

D.1.46 Monitor. A device that shows or gives warning of improper performance (noun); or to test or check performance on a continuing basis (verb).

D.1.47 Nacelle. The enclosed streamlined housing for a powerplant. A nacelle is usually shorter than a fuselage and does not carry the tail unit.

D.1.48 NATSF. Naval Air Technical Services Facility.

D.1.49 NAVAIR. Naval Air Systems Command.

D.1.50 NAVFAC. Naval Facilities Engineering Command.

D.1.51 NAVSEA. Naval Sea Systems Command.

D.1.52 NAVSUP. Naval Supply Systems Command.

D.1.53 NFPA. National Fire Protection Association.

D.1.54 OPNAVINST. Chief of Naval Operations Instruction.

D.1.55 Oxidizer.

D.1.55.1 A substance that readily gives up oxygen without requiring an equivalent of another element in return.

D.1.55.2 A substance that contains an atom or atomic group that gains electrons, such as oxygen, ozone, chlorine, hydrogen peroxide, nitric acid, metal oxides, chlorates, and permanganates (also called oxidizing agent).

D.1.56 Particulate matter. Solid contaminants (e.g., dirt, rust, scale, sand, etc.) sometimes found in fuel.

D.1.57 Pod. The enclosed streamlined housing around the jet engine.

D.1.58 POL. Petroleum, Oil, Lubricants.

D.1.59 Prefilter. A filter that has a high dirt-holding capacity that is installed up-stream of other filtration equipment.

D.1.60 Pressure drop. See Differential pressure above.

D.1.61 Pylon, nacelle strut. The structure that attaches a jet engine to the wing.

D.1.62 Relative density (specific gravity). In fuel, this is the ratio of weight of any volume of fuel to the weight of an equal volume of water.

D.1.63 Rudder. The upright movable part of the tail assembly that controls the direction (yaw) of the aircraft.

D.1.64. SDA. Static Dissipator Additive.

D.1.65 Settling time. The time allowed for water or dirt entrained in the fuel to drop to the bottom of the storage tank.

D.1.66 Slat. A movable auxiliary airfoil, the primary function of which is to increase the stability of the aircraft. Slats are found on the leading edge of the wing.

D.1.67 Specific gravity. See Relative density above.

D.1.68 Stabilizer. Any airfoil the primary function of which is to increase the stability of the aircraft. The term stabilizer is most commonly used in reference to the fixed horizontal tail surface of the aircraft.

D.1.69 Sump. A low point in a system for collection and removal of water and solid contaminants.

D.1.70 Surfactant. Any wetting agent.

D.1.71 Surfactants (surface active agents). Chemical substances that make it difficult to separate fuel and water and that disarm filter/separators.

D.1.72 T.A.U. Twin agent fire extinguisher.

D.1.73 T.O. Technical order.

D.1.74 Thief (sump) pump. A small pump having a suction which extends to the low point of a tank for the purpose of drawing off water that may have accumulated.

D.1.75 Turbine fuel. A group of various kerosines or wide-cut types of fuels used to power aircraft turbine engines.

D.1.76 TYCOM. Type Commander.

D.1.77 Water slug. A large amount of free water.

# CONCLUDING MATERIAL

Custodian:
Navy – AS

Preparing Activity:
Navy –AS
(Project 9130-1076)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using ASSIST Online database at http://www.dodssp.daps.mil.