



NAVAIR 00-80T-109

AIRCRAFT REFUELING NATOPS MANUAL

THIS PUBLICATION SUPERSEDES NAVAIR 00-80T-109 DATED 1 JUNE 2014.



DISTRIBUTION STATEMENT C — Distribution authorized to U.S. Government agencies only and their contractors to protect publications required for official use or for administrative or operational purposes only (1 July 2017). Other requests for this document shall be referred to Fuels & Lubricants Systems Engineer, AIR-4.4.5, Propulsion & Power Engineering Department, Naval Air Systems Command, 22229 Elmer Road, Unit 4, Bldg 2360, Patuxent River, MD 20670.

DESTRUCTION NOTICE — For unclassified, limited documents, destroy by any method that will prevent disclosure of contents or reconstruction of the document.

ISSUED BY AUTHORITY OF THE CHIEF OF NAVAL OPERATIONS AND UNDER THE DIRECTION OF THE COMMANDER, NAVAL AIR SYSTEMS COMMAND.

GENERAL 1

ABOARD SHIPS 2

AT SHORE
ACTIVITIES 3

IN TACTICAL UNITS 4

INDEX



**DEPARTMENT OF THE NAVY**

NAVAL AIR SYSTEMS COMMAND
RADM WILLIAM A. MOFFETT BUILDING
47123 BUSE ROAD, BLDG 2272
PATUXENT RIVER, MARYLAND 20670-1547

1 July 2017

LETTER OF PROMULGATION

1. The Naval Air Training and Operating Procedures Standardization (NATOPS) Program is a positive approach toward improving combat readiness and achieving a substantial reduction in the aircraft mishap rate. Standardization, based on professional knowledge and experience, provides the basis for development of an efficient and sound operational procedure. The standardization program is not planned to stifle individual initiative, but rather to aid the Commanding Officer in increasing the unit's combat potential without reducing command prestige or responsibility.
2. This manual standardizes ground and flight procedures but does not include tactical doctrine. Compliance with the stipulated manual requirements and procedures is mandatory except as authorized herein. In order to remain effective, NATOPS must be dynamic and stimulate rather than suppress individual thinking. Since aviation is a continuing, progressive profession, it is both desirable and necessary that new ideas and new techniques be expeditiously evaluated and incorporated if proven to be sound. To this end, Commanding Officers of aviation units are authorized to modify procedures contained herein, in accordance with the waiver provisions established by OPNAV Instruction 3710.7, for the purpose of assessing new ideas prior to initiating recommendations for permanent changes. This manual is prepared and kept current by the users in order to achieve maximum readiness and safety in the most efficient and economical manner. Should conflict exist between the training and operating procedures found in this manual and those found in other publications, this manual will govern.
3. Checklists and other pertinent extracts from this publication necessary to normal operations and training should be made and carried for use in naval aircraft.
4. Per NAVAIR Instruction 13034.1 series, this flight clearance product provides Naval Air Systems Command (NAVAIR) airworthiness certification subsequent to design engineering review. It does not authorize aircraft/system modification, nor does it satisfy NAVAIR requirements for configuration management. Refer to OPNAV Instruction 4790.2 series for policy guidance on configuration management and modification authority.

Approved

S. G. GAHAGAN
Rear Admiral, United States Navy
By direction of
Commander, Naval Air Systems Command



**INTERIM CHANGE SUMMARY**

The following Interim Changes have been cancelled or previously incorporated into this manual.

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE
1-9	Previously incorporated.

The following Interim Changes have been incorporated into this Change/Revision.

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE
10	F-35 28V Battery Note

Interim Changes Outstanding — To be maintained by the custodian of this manual.

INTERIM CHANGE NUMBER(S)	ORIGINATOR/DATE (or DATE/TIME GROUP)	PAGES AFFECTED	REMARKS/PURPOSE
This manual has been transitioned to electronic format only. Interim Changes and related replacement pages will no longer be issued with updates. Updates will be provided via release of a full electronic revision posted to the Airworthiness and NATEC Websites. Refer to the Record of Changes page 9/(10 blank) for specific details of the update.			





Summary of Applicable Technical Directives

Information relating to the following recent technical directives has been incorporated into this manual.

CHANGE NUMBER	DESCRIPTION	DATE INC. IN MANUAL	VISUAL IDENTIFICATION

Information relating to the following applicable technical directives will be incorporated in a future change.

CHANGE NUMBER	DESCRIPTION	DATE INC. IN MANUAL	VISUAL IDENTIFICATION



[illegible]



LIST OF EFFECTIVE PAGES

Effective Pages	Page Numbers
Original	1 (Reverse Blank)
Original	3 (Reverse Blank)
Original	5 (Reverse Blank)
Original	7 (Reverse Blank)
Original	9 (Reverse Blank)
Original	11 (Reverse Blank)
Original	13 thru 27 (Reverse Blank)
Original	29 thru 31 (Reverse Blank)
Original	33 thru 41 (Reverse Blank)
Original	1-1 thru 1-5 (Reverse Blank)
Original	43 (Reverse Blank)
Original	2-1 thru 2-2
Original	3-1 thru 3-12
Original	4-1 thru 4-6
Original	5-1 thru 5-7 (Reverse Blank)
Original	6-1 thru 6-27 (Reverse Blank)
Original	7-1 (Reverse Blank)
Original	45 (Reverse Blank)
Original	8-1 thru 8-5 (Reverse Blank)

Effective Pages	Page Numbers
Original	9-1 thru 9-15 (Reverse Blank)
Original	10-1 thru 10-6
Original	11-1 thru 11-17 (Reverse Blank)
Original	12-1 thru 12-42
Original	13-1 thru 13-17 (Reverse Blank)
Original	47 (Reverse Blank)
Original	14-1 thru 14-3 (Reverse Blank)
Original	15-1 thru 15-14
Original	16-1 thru 16-5 (Reverse Blank)
Original	17-1 thru 17-9 (Reverse Blank)
Original	18-1 thru 18-51 (Reverse Blank)
Original	19-1 thru 19-2
Original	A-1 thru A-12
Original	B-1 thru B-3 (Reverse Blank)
Original	C-1 thru C-3 (Reverse Blank)
Original	D-1 thru D-4
Original	E-1 thru E-7 (Reverse Blank)
Original	Index-1 thru Index-5 (Reverse Blank)





AIRCRAFT REFUELING

NATOPS MANUAL

CONTENTS

*Page
No.*

PART I — GENERAL

CHAPTER 1 — INTRODUCTION

1.1	PURPOSE	1-1
1.2	SCOPE	1-1
1.3	ORGANIZATION OF THIS PUBLICATION	1-1
1.4	FLIGHT CLEARANCE PRODUCTS	1-1
1.4.1	Flight Clearance Product Set	1-1
1.5	AIRCRAFT REFUELING NATOPS PROGRAM MANAGEMENT ASSIGNMENTS	1-2
1.5.1	NATOPS Model Manager	1-2
1.5.2	NATOPS Advisory Group	1-2
1.5.3	NATOPS Cognizant Command	1-3
1.6	CHANGE RECOMMENDATIONS AND QUESTIONS ABOUT AFLOAT SYSTEMS AND PROCEDURES	1-3
1.7	RESPONSIBILITIES	1-3
1.7.1	Commanding Officers	1-3
1.7.2	Fuel Maintenance/Management Officers (FMO)	1-3
1.7.3	Users	1-3
1.8	LOCAL INSTRUCTIONS	1-4
1.8.1	Conflicts With This Manual	1-4
1.9	CONTINUING REVIEW OF PRACTICES	1-4
1.10	WAIVERS	1-4
1.11	OTHER RELATED PUBLICATIONS	1-5

PART II — AIRCRAFT REFUELING ABOARD SHIPS

CHAPTER 2 — ORGANIZATION AND TRAINING ABOARD SHIPS

2.1	ORGANIZATION	2-1
2.2	TRAINING REQUIREMENTS	2-1





2.2.1	Formal Training	2-1

CHAPTER 3 — QUALITY SURVEILLANCE OF AVIATION FUELS ABOARD SHIPS

3.1	GENERAL REQUIREMENTS	3-1
3.2	SHIPBOARD AVIATION FUEL QUALITY SURVEILLANCE PROGRAM	3-1
3.2.1	Fuel Received by Ships that Fuel Aircraft	3-1
3.2.2	Fuel Dispensed to Aircraft by Ships	3-2
3.2.3	Routine Correlation Samples and Tests	3-2
3.3	SAMPLING PROCEDURES	3-3
3.3.1	General Rules	3-3
3.3.2	Sample Containers	3-4
3.3.3	Identification of Sample	3-4
3.3.4	Sample Classification	3-5
3.3.5	Shipping Instructions	3-5
3.4	FUEL LABORATORY, TEST EQUIPMENT, AND METHODS	3-6
3.4.1	Laboratory	3-6
3.4.2	Testing Equipment	3-6
3.4.3	Test Methods	3-7
3.5	INTERPRETATION OF TEST RESULTS	3-7
3.5.1	Test Results Action	3-7
3.5.2	Appearance (Visual Test)	3-8
3.5.3	Sediment/Particulates	3-8
3.5.4	Free Water	3-8
3.5.5	FSII	3-9
3.5.6	Other Test Results	3-9
3.5.7	Routine Correlation Samples	3-10
3.6	GUIDELINES FOR REQUESTING REGIONAL LABORATORY SERVICES	3-10
3.7	REGIONAL LABORATORY TEST METHODS AND REPORTING	3-10
3.7.1	Routine Samples	3-10
3.7.2	Special Samples	3-10
3.7.3	Reporting	3-10
3.7.4	Report Forms	3-11
3.7.5	Distribution Lists for Reports	3-11
3.7.6	Message Reports	3-12
3.8	PROCEDURES FOR PREVENTING AND CONTROLLING CONTAMINATION	3-12



**CHAPTER 4 — SAFETY IN SHIPBOARD FUEL HANDLING OPERATIONS**

4.1	INTRODUCTION	4-1
4.2	SPECIAL SHIPBOARD SAFETY PRECAUTIONS	4-1
4.3	ELIMINATING SOURCES OF IGNITION	4-2
4.3.1	Reducing Electrostatic Charges	4-2
4.3.2	Eliminating Other Sources of Ignition	4-3
4.4	REDUCING OR CONTROLLING VAPOR GENERATION	4-3
4.5	MISCELLANEOUS SAFETY PROCEDURES	4-3
4.6	EXTINGUISHING FIRES	4-4
4.7	MINIMIZING HEALTH HAZARDS	4-4
4.8	UNIFORMS	4-4
4.8.1	Flight Deck Uniforms	4-4
4.8.2	Hangar Deck Uniforms	4-5
4.9	CONFINED SPACES	4-5
4.10	AVIATION FUELS SECURITY WATCH	4-5
4.10.1	Basic Function	4-5
4.10.2	Fuels Watch	4-5
4.10.3	Duties, Responsibilities, and Authority	4-6

CHAPTER 5 — SHIPBOARD AIRCRAFT REFUELING SYSTEM AND EQUIPMENT

5.1	GENERAL REQUIREMENTS	5-1
5.1.1	Filtration Requirements	5-1
5.1.2	Maximum Refueling Pressure	5-1
5.1.3	Pressure Refueling Nozzles	5-1
5.1.4	Nozzle Flushing Connection	5-1
5.1.5	Hose End Pressure Regulator (HEPR)	5-1
5.1.6	Unisex Couplings	5-2
5.2	SHIPBOARD AIRCRAFT REFUELING SYSTEMS	5-2
5.2.1	On-Deck Refueling Systems	5-2
5.2.2	Helicopter In-Flight Refueling Equipment	5-2
5.2.3	Fuel Testing Laboratory	5-3

CHAPTER 6 — SHIPBOARD OPERATING PROCEDURES

6.1	INTRODUCTION	6-1
6.2	SHIPBOARD AIRCRAFT REFUELING PROCEDURES	6-1
6.2.1	Operation of the JP-5 System	6-1
6.2.2	Log Books	6-2





6.2.3	Aircraft Pressure Refueling with Engines Off (Cold Refueling)	6-2
6.2.4	Overwing Refueling	6-5
6.2.5	Aircraft Pressure Refueling with Engines Operating (Hot Refueling)	6-8
6.2.6	Helicopter In-Flight Refueling (HIFR) Procedures	6-9
6.2.7	Refueling Aircraft with Auxiliary Power Unit (APU) Running	6-11
6.2.8	Concurrent On-Loading/Off-Loading and Refueling of Aircraft	6-11
6.2.9	Defueling Aircraft	6-16
6.2.10	Handling of Aircraft Containing Fuel Other Than JP-5	6-22
6.2.11	Handling NATO F-37 (JP-8+100) and F-27 (F-24+100) Fuel	6-26
6.2.12	Precertification Refueling	6-26
6.2.13	Shipboard Refueling Procedures for Commercial Contract Helicopters	6-27
6.2.14	Support of Aircraft Inflight Refueling Probe Maintenance	6-27

CHAPTER 7 — SHIPBOARD PREVENTIVE MAINTENANCE

PART III — AIRCRAFT REFUELING AT SHORE ACTIVITIES

CHAPTER 8 — ORGANIZATION AND TRAINING AT SHORE ACTIVITIES

8.1	ORGANIZATION	8-1
8.1.1	Responsibilities	8-1
8.1.2	Duties	8-2
8.2	TRAINING REQUIREMENTS	8-4
8.2.1	General Training Requirements	8-4
8.2.2	Refueling Vehicle Operator Certification	8-4
8.2.3	Nozzle Operators' Training and Certification	8-4

CHAPTER 9 — QUALITY SURVEILLANCE OF AVIATION FUELS AT SHORE ACTIVITIES

9.1	GENERAL REQUIREMENTS	9-1
9.2	AVIATION FUEL QUALITY SURVEILLANCE PROGRAM	9-1
9.2.1	Fuel Receipts	9-2
9.2.2	Fuel in Storage Tanks at Shore Stations	9-3
9.2.3	Fuel Issued to Aircraft	9-4
9.2.4	Routine Correlation Sampling and Testing	9-5
9.3	SAMPLING PROCEDURES	9-5
9.3.1	General Rules	9-6
9.3.2	Sample Containers	9-6
9.3.3	Identification of Sample	9-7
9.3.4	Sample Classification	9-7
9.3.5	Shipping Instructions	9-7





9.4	FUEL LABORATORY, TEST EQUIPMENT, AND METHODS	9-8
9.4.1	Laboratory	9-8
9.4.2	Testing Equipment	9-8
9.4.3	Test Methods	9-9
9.5	INTERPRETATION OF TEST RESULTS	9-9
9.5.1	Appearance (Visual Test)	9-10
9.5.2	Sediment/Particulates	9-10
9.5.3	Free Water	9-10
9.5.4	FSII	9-11
9.5.5	Other Test Results	9-11
9.5.6	Routine Correlation Samples	9-12
9.5.7	Aircraft Low Point Drain Samples	9-12
9.6	GUIDELINES FOR REQUESTING REGIONAL LABORATORY SERVICES	9-12
9.7	REGIONAL LABORATORY TEST METHODS AND REPORTING	9-12
9.7.1	Routine Samples	9-12
9.7.2	Special Samples	9-13
9.7.3	Reporting	9-13
9.7.4	Report Forms	9-13
9.7.5	Distribution Lists for Reports	9-13
9.7.6	Message Reports	9-14
9.8	PROCEDURES FOR PREVENTING AND CONTROLLING CONTAMINATION	9-14

CHAPTER 10 — SAFETY IN SHORE ACTIVITY FUEL HANDLING OPERATIONS

10.1	INTRODUCTION	10-1
10.2	ELIMINATING SOURCES OF IGNITION	10-1
10.2.1	Reducing Electrostatic Charges	10-1
10.2.2	Eliminating Other Sources of Ignition	10-2
10.3	REDUCING OR CONTROLLING VAPOR GENERATION	10-3
10.4	EXTINGUISHING FIRES	10-3
10.5	MINIMIZING HEALTH HAZARDS	10-4
10.6	CONFINED SPACES	10-4
10.7	WEAPONS HANDLING PROCEDURES	10-5

CHAPTER 11 — SHORE ACTIVITY FACILITIES AND EQUIPMENT

11.1	GENERAL REQUIREMENTS	11-1
11.1.1	Filtration Requirements	11-1
11.1.2	Maximum Refueling Pressure	11-1





11.1.3	General Design and Repair Requirements	11-1
11.1.4	Refueling Equipment Markings and Painting	11-2
11.1.5	Illumination	11-2
11.1.6	Electrical Equipment	11-2
11.2	REFUELING EQUIPMENT	11-2
11.2.1	Filter/Separators	11-3
11.2.2	Relaxation Chambers	11-4
11.2.3	Fuel Meters	11-4
11.2.4	Fuel Pressure Gauges	11-4
11.2.5	Sampling Connections†	11-4
11.2.6	Hoses	11-4
11.2.7	Emergency Dry Breakaway Coupling†	11-4
11.2.8	Dry Break Quick Disconnect Coupling†	11-4
11.2.9	Hose End Pressure Regulator†	11-4
11.2.10	Aircraft Refueling Nozzles†	11-5
11.3	AIRCRAFT FUELING SYSTEMS	11-5
11.3.1	Aircraft Direct Fueling Systems	11-5
11.3.2	Mobile Aircraft Refuelers	11-9
11.3.3	Portable Fueling Systems	11-11
11.4	PORTABLE CLIMATE SHELTERS	11-11
11.5	AIRCRAFT DEFUELING EQUIPMENT	11-12
11.5.1	Refuelers/Defuelers	11-12
11.5.2	Defuelers	11-12
11.6	AIRCRAFT REFUELER TRUCK FILL STANDS	11-13
11.7	TRUCK PARKING AREAS	11-14
11.7.1	Condition of Truck Parking Areas	11-14
11.7.2	Refueling Vehicle Parking Area Requirements	11-14
11.8	RECEIVING STATIONS	11-14
11.9	STORAGE TANKS	11-14
11.10	TRANSFER LINES	11-16
11.11	FUEL DIVISION SPACES	11-16
11.11.1	Fuel Office	11-16
11.11.2	Fuel Crew Ready/Training Room	11-16
11.11.3	Fuel Workshop	11-16
11.11.4	Fuel Division Storeroom	11-16
11.11.5	Fuel Division Laboratory	11-16





11.12	MISCELLANEOUS FUEL DIVISION SAFETY EQUIPMENT	11-17

CHAPTER 12 — OPERATING PROCEDURES FOR SHORE ACTIVITIES

12.1	INTRODUCTION	12-1
12.2	GENERAL OPERATING PROCEDURES	12-1
12.2.1	Spill Prevention and Control	12-1
12.2.2	Surge Pressure Control	12-2
12.2.3	Night Vision Goggles	12-3
12.3	REFUELING AIRCRAFT AT DIRECT FUELING STATIONS WITH ENGINES OFF (COLD REFUELING)	12-3
12.3.1	Pressure Refueling	12-3
12.3.2	Overwing (Gravity) Refueling	12-9
12.4	TRUCK OPERATIONS	12-11
12.4.1	Truck Fill Stands	12-11
12.4.2	Cold Refueling Aircraft with Trucks	12-12
12.4.3	Refueler Parking	12-23
12.5	FUELING WITH ENGINES OPERATING (HOT REFUELING)	12-23
12.5.1	Personnel Requirements	12-23
12.5.2	Equipment Requirements	12-23
12.5.3	Hot Refueling Procedures	12-25
12.6	MULTIPLE SOURCE REFUELING	12-31
12.7	PIGGYBACK REFUELING	12-32
12.8	TRANSFERRING FUEL FROM ONE AIRCRAFT TO ANOTHER	12-32
12.9	REFUELING AIRCRAFT WITH AUXILIARY POWER UNIT (APU) RUNNING	12-32
12.10	CONCURRENT ON-LOADING/OFF-LOADING AND REFUELING OF AIRCRAFT	12-33
12.11	DEFUELING AIRCRAFT	12-33
12.11.1	Personnel Requirements	12-36
12.11.2	Defueling Procedures	12-36
12.11.3	Disposition of Nonsuspect Fuel Removed from Aircraft	12-37
12.11.4	Disposition of Suspect Fuel Removed from Any Aircraft	12-38
12.11.5	Handling NATO F-37 (JP-8+100)/F-27 (F-24+100) Fuel	12-38
12.11.6	Disposition of Fuel that Does Not Meet the Allowable Deterioration Limits	12-39
12.12	SHORE STATION REFUELING PROCEDURES FOR COMMERCIAL CONTRACT HELICOPTERS	12-39
12.13	PRODUCT RECEIPT	12-39
12.13.1	Barge or Tanker Receipt of Product	12-39





12.13.2	Pipeline Receipt of Product	12-40
12.13.3	Tank Truck/Tank Car Receipt of Product	12-40
12.13.4	Aviation Fuel Settling	12-41
12.14	CHANGE OF PRODUCT IN AIRCRAFT REFUELERS	12-41
12.15	CHANGE OF PRODUCT IN STORAGE TANKS	12-41

CHAPTER 13 — MAINTENANCE OF REFUELING FACILITIES AT SHORE ACTIVITIES

13.1	GENERAL REQUIREMENTS	13-1
13.2	RESPONSIBILITIES	13-1
13.3	PREVENTIVE MAINTENANCE PROGRAM (INSPECTIONS)	13-1
13.3.1	Inspections Prior to Use	13-2
13.3.2	Seasonal or Special Inspections	13-2
13.3.3	Aircraft Refueling Equipment Checklists	13-2
13.3.4	Filter/Separator — Pressure Log and Graph	13-14
13.3.5	Filter/Separator Element Change	13-14
13.3.6	Storage and Distribution Facilities Checklist	13-14
13.3.7	Calibration	13-15
13.4	RECORDS AND REPORTS	13-15
13.4.1	Record Retention	13-15

PART IV — AIRCRAFT REFUELING IN TACTICAL UNITS

CHAPTER 14 — ORGANIZATION AND TRAINING FOR TACTICAL FUEL OPERATIONS

14.1	ORGANIZATION	14-1
14.1.1	Responsibilities	14-1
14.1.2	Duties of Personnel Refueling Aircraft	14-2
14.2	TRAINING REQUIREMENTS	14-2
14.2.1	General Training Requirements	14-2
14.2.2	Refueling Vehicle Operator Certification	14-2
14.2.3	Nozzle Operators' Training and Certification	14-2

CHAPTER 15 — QUALITY SURVEILLANCE OF AVIATION FUELS FOR TACTICAL UNITS

15.1	GENERAL REQUIREMENTS	15-1
15.2	AVIATION FUEL QUALITY SURVEILLANCE PROGRAM	15-1
15.2.1	Fuel Receipts	15-1
15.2.2	Fuel in Collapsible Storage Tanks	15-3
15.2.3	Fuel Issued to Aircraft	15-3





15.2.4	Routine Verification Sampling and Testing	15-4
15.3	SAMPLING PROCEDURES	15-4
15.3.1	General Rules	15-5
15.3.2	Sample Containers	15-5
15.3.3	Identification of Sample	15-6
15.3.4	Sample Classification	15-6
15.3.5	Shipping Instructions	15-7
15.4	FUEL TESTING STATION, TEST EQUIPMENT, AND METHODS	15-7
15.4.1	Fuel Testing Station	15-7
15.4.2	Testing Equipment	15-7
15.4.3	Test Methods	15-9
15.5	INTERPRETATION OF TEST RESULTS	15-9
15.5.1	Appearance (Visual Test)	15-9
15.5.2	Sediment/Particulates	15-9
15.5.3	Free Water	15-10
15.5.4	FSII	15-10
15.5.5	Other Tests Results	15-11
15.5.6	Routine Verification Samples	15-11
15.6	GUIDELINES FOR REQUESTING LABORATORY SERVICES	15-12
15.7	REGIONAL LABORATORY TEST METHODS AND REPORTING	15-12
15.7.1	Routine Samples	15-12
15.7.2	Special Samples	15-12
15.7.3	Reporting	15-12
15.7.4	Report Forms	15-12
15.7.5	Distribution Lists for Reports	15-13
15.7.6	Message Reports	15-13
15.8	PROCEDURES FOR PREVENTING AND CONTROLLING CONTAMINATION	15-13

CHAPTER 16 — SAFETY IN TACTICAL FUEL HANDLING OPERATIONS

16.1	INTRODUCTION	16-1
16.2	ELIMINATING SOURCES OF IGNITION	16-1
16.2.1	Reducing Electrostatic Charges	16-1
16.2.2	Eliminating Other Sources of Ignition	16-2
16.3	REDUCING OR CONTROLLING VAPOR GENERATION	16-3
16.4	EXTINGUISHING FIRES	16-4
16.5	MINIMIZING HEALTH HAZARDS	16-4





16.6	CONFINED SPACES	16-5

CHAPTER 17 — TACTICAL FUEL SYSTEMS AND EQUIPMENT

17.1	GENERAL REQUIREMENTS	17-1
17.1.1	Filtration Requirements	17-1
17.1.2	Maximum Refueling Pressure	17-1
17.1.3	Mobile Refueler Marking	17-1
17.2	COMMON REFUELING EQUIPMENT/COMPONENTS	17-2
17.2.1	Filter/Separators	17-2
17.2.2	Relaxation Design	17-2
17.2.3	Fuel Meters	17-3
17.2.4	Hoses and Couplings	17-3
17.2.5	Hose End Pressure Regulator†	17-3
17.2.6	Aircraft Refueling Nozzles†	17-3
17.3	TACTICAL FUEL SYSTEMS/EQUIPMENT	17-3
17.3.1	Tactical Airfield Fuel Dispensing System (TAFDS)	17-4
17.3.2	Helicopter Expedient Refueling System (HERS)	17-4
17.3.3	Navy Advanced Base Functional Components Fueling Systems (ABFC-H14K)	17-6
17.3.4	Mobile Aircraft Refuelers (MK970)	17-6
17.4	AIRCRAFT DEFUELING EQUIPMENT	17-7
17.4.1	Refuelers/Defuelers	17-7
17.4.2	Defuelers	17-7
17.5	TRUCK PARKING AREAS	17-9
17.5.1	Condition of Truck Parking Areas	17-9
17.5.2	Parking Area Requirements	17-9
17.6	RECEIVING SITES	17-9
17.7	STORAGE TANKS	17-9

CHAPTER 18 — OPERATING PROCEDURES FOR TACTICAL FUEL UNITS

18.1	INTRODUCTION	18-1
18.2	GENERAL OPERATING PROCEDURES	18-1
18.2.1	Spill Prevention and Control	18-1
18.2.2	Surge Pressure Control	18-2
18.3	REFUELING AIRCRAFT AT STATIONARY SYSTEMS (TAFDS AND HERS) WITH ENGINES OFF (COLD REFUELING)	18-3
18.3.1	Pressure Refueling	18-3
18.3.2	Overwing/Open-Port (Gravity Refueling)	18-6
18.4	TRUCK OPERATIONS	18-8





18.4.1	Filling Mobile Refueling Equipment (e.g., Rigid Tanks)	18-8
18.4.2	Cold Refueling Aircraft with Mobile Refuelers	18-10
18.4.3	Refueler Parking	18-16
18.5	FUELING WITH ENGINES OPERATING (HOT REFUELING)	18-16
18.5.1	Personnel Requirements	18-16
18.5.2	Equipment Requirements	18-16
18.5.3	Hot Refueling Procedures	18-17
18.6	MULTIPLE SOURCE REFUELING	18-21
18.7	TRANSFERRING FUEL FROM ONE AIRCRAFT TO ANOTHER	18-22
18.8	REFUELING AIRCRAFT WITH AUXILIARY POWER UNIT (APU) IN OPERATION	18-22
18.9	CONCURRENT ON-LOADING/OFF-LOADING AND REFUELING OF AIRCRAFT	18-22
18.10	DEFUELING AIRCRAFT	18-23
18.10.1	Personnel Requirements	18-24
18.10.2	Defueling Procedures	18-25
18.10.3	Disposition of Nonsuspect Fuel Removed from Aircraft	18-26
18.10.4	Disposition of Suspect Fuel Removed from Any Aircraft	18-26
18.10.5	Handling NATO F-37 (JP-8+100)/F-27 (F-24+100) Fuel	18-26
18.10.6	Disposition of Fuel that Does Not Meet the Allowable Deterioration Limits	18-27
18.11	PRODUCT RECEIPT	18-27
18.11.1	Bulk Transfer Line Receipt of Product	18-27
18.11.2	Tank Truck/Tank Car Receipt of Product	18-28
18.11.3	Fabric Drums or 55-Gallon Metal Drums Receipt of Product	18-28
18.11.4	Change of Product in Aircraft Defuelers	18-29
18.11.5	Change of Product in Storage Tanks	18-29
18.12	FORWARD ARMING AND REFUELING POINT (FARP) PROCEDURES	18-29
18.12.1	Personnel Requirements	18-29
18.12.2	Equipment Requirements	18-29
18.12.3	Communication Procedures	18-30
18.12.4	Fueling Helicopters with Engines Not Operating (Cold Refueling)	18-31
18.12.5	Fueling with Engines Operating (Hot Refueling)	18-38
18.12.6	Attack/Utility FARP Hot Refueling Sequence of Events	18-45

CHAPTER 19 — MAINTENANCE OF TACTICAL FUELING EQUIPMENT

19.1	GENERAL REQUIREMENTS	19-1
19.2	AIRCRAFT REFUELING EQUIPMENT CHECKLISTS	19-1





19.2.1	Daily Checklist	19-1
19.2.2	Weekly Checklist	19-1
19.2.3	Monthly Checklist	19-1
19.2.4	Periodic Inspection and Annual Record	19-1

**APPENDIX A — AVIATION FUELS QUALITY SURVEILLANCE LOGS, FUELS
ACCOUNTABILITY LOGS, AND LABELS**

APPENDIX B — AVIATION FUEL DETERIORATION USE LIMITS

APPENDIX C — AVIATION FUEL DIVISION CONTINUING TRAINING SYLLABUS

**APPENDIX D — AUTHORIZED AIR STATION AIRCRAFT REFUELING
SYSTEM COMPONENTS**

**APPENDIX E — SHIPBOARD HOT REFUELING PROCEDURES IN SUPPORT
OF SPECIAL OPERATIONS MISSIONS**

E.1	PURPOSE	E-1
E.2	INTRODUCTION	E-1
E.3	RESPONSIBILITIES	E-1
E.4	HOT REFUELING REQUIREMENTS	E-2
E.5	HOT REFUELING WITH ZODIAC BAGS	E-2
E.5.1	Equipment and Manpower Requirements	E-2
E.5.2	Factors to Mitigate Hot Overwing Refueling Risks with Z-Bags	E-3
E.5.3	Hot Overwing Z-Bag Refueling Procedures	E-3
E.6	HOT OVERWING REFUELING	E-7

INDEX	Index-1





LIST OF ILLUSTRATIONS

	<i>Page No.</i>
CHAPTER 5 — SHIPBOARD AIRCRAFT REFUELING SYSTEM AND EQUIPMENT	
Figure 5-1. Shipboard Aircraft Fueling System Flow Diagram — Carrier and Amphibious Assault Aviation Ships	5-4
Figure 5-2. Shipboard Aircraft Refueling System Flow Diagram — Air-Capable Ships	5-5
Figure 5-3. NATO High-Capacity (NHC) HIFR Assembly	5-6
Figure 5-4. NHC Flushing Adapter and Pressure Refueling Nozzles	5-7
CHAPTER 6 — SHIPBOARD OPERATING PROCEDURES	
Figure 6-1. Electrical Bonding of Overwing Refueling Nozzle to Aircraft	6-7
Figure 6-2. Sample CG NHC Layout	6-12
Figure 6-3. Sample DDG NHC Layout	6-13
Figure 6-4. Sample FFG NHC Layout	6-14
Figure 6-5. NATO High Capacity Assembly Attached to Helicopter Hoist Hook	6-15
Figure 6-6. Aircraft Defueling Certificate	6-18
Figure 6-7. Plane-to-Plane Transfer Cart	6-24
Figure 6-8. Aircraft-to-Aircraft Mixed Fuel Transfer Certificate	6-25
CHAPTER 8 — ORGANIZATION AND TRAINING AT SHORE ACTIVITIES	
Figure 8-1. Typical Shore Activity Organization	8-2
Figure 8-2. Typical Government Owned Contractor Operated Facility	8-3
CHAPTER 11 — SHORE ACTIVITY FACILITIES AND EQUIPMENT	
Figure 11-1. Shore Activity Fuel System Flow Schematic	11-6
Figure 11-2. Aircraft Direct Refueling Station	11-7
Figure 11-3. Truck Fill Stand	11-8
Figure 11-4. Hot Refueling with Truck and Pantograph	11-9
CHAPTER 12 — OPERATING PROCEDURES FOR SHORE ACTIVITIES	
Figure 12-1. Direct Refueling Station Log	12-4
Figure 12-2. Bonding of Aircraft to Direct Refueling Station	12-8
Figure 12-3. Bonding and Grounding Via Nozzle Connection	12-9
Figure 12-4. Electrical Bonding of Overwing Refueling Nozzle to Aircraft	12-11
Figure 12-5. Aircraft Refueling Dispatch Log	12-13
Figure 12-6. Normal Refueler Approach Path and Refueling Safety Zone	12-15
Figure 12-7. Alternate Refueler Approach Paths	12-15
Figure 12-8. Refueler Approach to Prop, Prop/Jet, and Transport Aircraft	12-16
Figure 12-9. Alternate Refueler Approach to a Helicopter	12-16





Figure 12-10.	Electrical Bonding of Aircraft and Truck (Cold Refueling)	12-21
Figure 12-11.	Positioning of Aircraft for Pantograph Refueling	12-28
Figure 12-12.	Aircraft Defueling Certificate	12-35
Figure 12-13.	Change of Grade Procedures for Aircraft Refuelers	12-42

CHAPTER 13 — MAINTENANCE OF REFUELING FACILITIES AT SHORE ACTIVITIES

Figure 13-1.	Daily Aircraft Refueling Equipment Checklist	13-3
Figure 13-2.	Weekly Aircraft Refueling Equipment Checklist	13-4
Figure 13-3.	Monthly Aircraft Refueling Equipment Checklist	13-5
Figure 13-4.	Periodic and Annual Report	13-6
Figure 13-5.	Filter/Separator Pressure Drop Log	13-10
Figure 13-6.	Filter/Separator Pressure Drop Graph	13-16
Figure 13-7.	Daily Storage and Distribution Facilities Checklist	13-17

CHAPTER 17 — TACTICAL FUEL SYSTEMS AND EQUIPMENT

Figure 17-1.	Tactical Airfield Fuel Dispensing System (TAFDS)	17-4
Figure 17-2.	Helicopter Expedient Refueling System (HERS)	17-5
Figure 17-3.	Navy Advanced Base Functional Components Fueling Systems (ABFC-H14K)	17-8
Figure 17-4.	ABFC-H14K System Schematic	17-8

CHAPTER 18 — OPERATING PROCEDURES FOR TACTICAL FUEL UNITS

Figure 18-1.	Multi-Point FARP for UH-1/AH-1 Helicopters (Cold, On Line)	18-33
Figure 18-2.	Standard Assault Hot FARP	18-41
Figure 18-3.	Integrated Assault/Attack Hot FARP	18-42
Figure 18-4.	Static FARP Layout	18-47

APPENDIX A — AVIATION FUELS QUALITY SURVEILLANCE LOGS, FUELS ACCOUNTABILITY LOGS, AND LABELS

Figure A-1.	Aviation Fuel Quality Surveillance Log	A-2
Figure A-2.	Aviation Fuel Contamination Fuel Detector Correlation Log	A-3
Figure A-3.	Aviation Fuel B/2 Test Kit (FSII) Correlation Log	A-4
Figure A-4.	Aviation Fuel Sample Label	A-5
Figure A-5.	Testing Laboratory Aviation Fuel Result Report Form	A-6
Figure A-6.	Shipboard Fuel Sample Log	A-7
Figure A-7.	Shipboard Filter Sample/Pressure Drop Log	A-8
Figure A-8.	Equipment Running Log	A-9
Figure A-9.	Daily Aircraft Fuel/Defuel Log	A-10
Figure A-10.	Refueling Card	A-11
Figure A-11.	V-4 Division Daily Fuels Report	A-12





APPENDIX B — AVIATION FUEL DETERIORATION USE LIMITS

Figure B-1.	Deterioration Use Limits for Aviation Turbine Fuels and Aviation Gasoline (Specifications MIL-DTL-5624, MIL-DTL-83133, and ASTM D910)	B-1

APPENDIX D — AUTHORIZED AIR STATION AIRCRAFT REFUELING SYSTEM COMPONENTS

Figure D-1.	Authorized Air Station Aircraft Refueling System Components	D-1

APPENDIX E — SHIPBOARD HOT REFUELING PROCEDURES IN SUPPORT OF SPECIAL OPERATIONS MISSIONS

Figure E-1.	Initial Arrangement of Z-Bag For Overwing Hot Refueling	E-4
Figure E-2.	Z-Bag Refueling in Progress	E-5
Figure E-3.	Z-Bag Being Lifted To Permit Fuel To Drain Into Tank	E-6
Figure E-4.	Z-Bag Hose Rotated Toward Aircraft Fuel Port	E-7





GLOSSARY

This glossary consists primarily of commonly used acronyms. Since many words are defined within the text of this NATOPS manual, please refer to the index for words and terms not found below. In addition, Appendix D of MIL-HDBK-844B(AS) contains a more extensive glossary of aircraft refueling terms.

A

AFOSS. Aviation fuel operational sequencing systems — the set of detailed instructions that cover the operation of shipboard aviation fuel systems.

APU. Auxiliary power unit — a small turbine engine on an aircraft that provides power when the main engine(s) is not operating. Also see IPP, GTC, and GTS.

ARC. Aviation refueling capable — 5,000–gallon mobile refueler.

B

B/2 anti-icing test kit. Fuel test kit that contains an instrument to measure the FSII content of the fuel.

B/2 refractometer. Instrument used to measure the FSII content on fuel.

Bonding. The act of providing an electrical connection between two objects (i.e., an aircraft and a refueling truck).

Bulk Storage Tank. Storage tank for fuel normally received by pipeline, tank truck, or tank car. For aviation turbine fuel, configure tank to supply fuel to operating storage tanks, either directly tank-to-tank, or indirectly by issuing fuel to tank trucks, tank cars, barges, ships, or pipelines.

BuNo. Bureau number — number designation assigned to each aircraft.

C

CCFD. Combined contaminated fuel detector — device used to test fuel for both water and sediment/particulate contamination.

CCR. Closed circuit refueling — nozzle and receptacle system used on US Army helicopters.

CFD. Contaminated fuel detector — device that is used to test fuel for sediment/particulate contamination.

CONFLAG stations. Conflagration stations — shipboard locations where firefighting equipment controls are installed.

D

D-1. SPR aircraft refueling nozzle with a 45-degree elbow.

D-1R. SPR aircraft refueling nozzle with a 45-degree elbow and a hose end pressure regulator.

D-2. SPR aircraft refueling nozzle with straight body.

D-2R. SPR aircraft refueling nozzle with straight body and a hose end pressure regulator.

D-3. SPR aircraft refueling nozzle with a variable inlet.

D-3R. SPR aircraft refueling nozzle with a variable inlet and a hose end pressure regulator.

Deadman control. A device that governs (controls) the primary pressure/flow valve in a refueling system. The valve opens only when an operator applies pressure to the handle, trigger, etc. If pressure is removed, the valve closes and fuel flow stops.

Defueling. Removing fuel from an aircraft.

Deterioration use limits. The minimum physical and chemical property requirements for fuel to be used in an aircraft.

DFWD. Digital Free Water Detector - device that measures the free-water content of a fuel sample.

DIEGME. FSII used in military aviation turbine fuels.

E

Earthing. The act of providing an electrical connection between an object (e.g., aircraft) and the Earth (or ground).

F

F-76. Shipboard distillate fuel (used in diesel and ship turbine engines).





FC. Fuels chief — Marine Corps term for the assistant fuels officer. Equivalent to the AFMO at a Navy shore station.

Flushing. The operation of a fuel system where fuel is pumped from one tank through a filter separator to a different tank. This action serves to flush out the lines with clean/dry fuel.

FMO. Fuel maintenance officer on ships and fuel management officer at navy shore stations. The title assigned to the full-time functional head of integrated fuel operations at an activity.

FO. Fuels officer — Marine Corps term for the fuels commodity manager and/or the functional head of a fuels organization. Equivalent to an FMO at a Navy shore station.

Free water standard. A color intensity comparator standard used in the FWD for determining the free water content of fuel.

FSII. Fuel system icing inhibitor — a fuel additive that prevents formation of water ice and microbiological growth in the fuel.

FWD. Free-water detector — device that measures the free-water content of a fuel sample.

G

Gammon fitting. Common name applied to the jet test QD (quick disconnect) couplings used in refueling nozzles and other places to take fuel samples.

Grounding. The act of providing an electrical connection between an object (e.g., aircraft) and the ground (Earth).

GTS. Gas turbine starter — an onboard aircraft starting system.

H

HEPR. Hose end pressure regulator — device that limits fuel pressure entering the aircraft to a set maximum.

HIFR. Helicopter in-flight refueling — refueling a helicopter from a ship while it hovers over the deck.

Hot refueling. Refueling an aircraft with one or more main engines running (not to include APU).

I

IPP. Integrated power pack — a small turbine engine used on the Joint Strike Fighter (JSF) that provides power when the main engine is not operating.

M

M970. Semitrailer, tank, 5,000-gallon fuel dispensing, under/overwing aircraft nozzles.

MOGAS. Automotive gasoline.

O

Operating Storage Tanks. Storage tank for aviation turbine fuel configured to issue fuel directly to an aircraft, hydrant system, or refueler.

OSS. Operational sequencing system — the set of detailed instructions that cover the operation of shipboard fuel systems.

P

Pantograph. A device used at shore stations to refuel aircraft. It is composed of a series of pieces of pipe, supported by rollers, and connected by swivel joints. One end of the device is connected to a fuel source while the other end has a short hose with an aircraft refueling nozzle attached.

PKP. A dry chemical fire extinguisher containing potassium bicarbonate.

Q

QAR. Quality assurance representative — a DLA employee who observes the sampling and testing of fuel at the time of acceptance by the US government.

Quality assurance. Fuel quality control measures (sampling and testing) that are performed on the fuel at the refinery.

Quality surveillance. Fuel quality control efforts (sampling and testing) that are performed on the fuel from the time it leaves the refinery until it is consumed by an aircraft.

R

Recirculation. The operation of a fuel system where fuel is pumped from a tank through a filter/separator and back into the tank. The action serves two purposes —





it flushes out the lines downstream of the filter/separator with clean/dry fuel and cleans up the fuel in the tank.

Refueling. Loading fuel onto an aircraft.

S

Safed. The replacement of any mechanical arming level, safety pin, electrical interrupt plug/pin, securing of armament switches, and/or any appropriate action that renders the particular ordnance carried as safe.

Service fuel. Shipboard term for fuel that has been filtered (or purified by a centrifugal) purifier, and transferred to a tank where it will be pumped to an aircraft.

SPR. Single-point pressure refueling — pressure refueling an aircraft through a single connection.

T

TAU. Twin agent unit — a fire extinguisher that expels two different firefighting materials at the same time.





LIST OF ABBREVIATIONS AND ACRONYMS

A

AAFS. Amphibious assault fuel system.

ABF. Aviation boatswain's mate fuels.

ABFC-H14K. Advanced base functional components fueling systems.

ACHO. Aircraft handling officer (shipboard operations).

AFMO. Assistant fuel management officer at a navy shore station.

AFOSS. Aviation fuel operational sequencing systems.

ALF. Auxiliary landing field.

ANSI. American national standards institute.

API. American petroleum institute.

APU. Auxiliary power unit.

ARFF. Aircraft rescue and firefighting.

ASME. American society of mechanical engineers.

ASTM. American society for testing and materials.

AVGAS. Aviation gasoline.

B

BuNo. Bureau number.

C

CCFD. Combined contaminated fuel detector.

CCR. Closed circuit refueling.

CFD. Contaminated fuel detector.

CFR. Crash, fire, rescue.

CNATTU. Center for Naval Aviation Technical Training Unit.

CNO. Chief of Naval Operations.

CO. Commanding officer.

CONFLAG stations. Conflagration stations.

COR. Contracting officer's representative.

CVN. Aircraft carrier, nuclear powered.

D

DEFCON. Defense condition.

DESC. Digital Free Water Detector.

DFWD. Digital Free Water Detector.

DiEGME. DiEthylene glycol mono methyl ether.

DLA. Defense logistics agency.

DLCS. Dedicated local control station.

DOD. Department of defense.

E

EIV. Eductor isolation valve.

EMS. Eductor mode switch.

EOOW. Engineer officer of the watch.





EPA. Environmental protection agency.

EVO. Electric valve operators.

F

FAA. Federal aviation administration.

FARP. Forward arming and refueling point.

FAS. Fueling at-sea station.

FC. Fuels chief.

FCV. Fuel control valve.

FFG. Guided missile frigates.

FMF. Fleet marine force.

FMO. Fuel maintenance officer.

FO. Fuels officer.

FOB. Forward operating base.

FOD. Foreign object damage.

FOR. Fuel oil reclaimed.

FSII. Fuel system icing inhibitor.

FWD. Free-water detector.

G

GSO. General specifications for overhaul.

GTC. Gas turbine compressor.

GTS. Gas turbine starter.

H

HDPE. High density polyethylene.

HEPR. Hose end pressure regulator.

HERS. Helicopter expedient refueling system.

HIFR. Helicopter in-flight refueling.

I

IMER. Improved multiple ejector rack.

ITER. Improved triple ejector rack.

ITS. Individual training standards (Marine Corps).

IPP. Integrated power pack.

L

LDPE. Low density polyethylene.

LHA. Amphibious assault ship.

Line NCO. Line noncommissioned officer.

LOX. Liquid oxygen.

LPD. Amphibious transport dock ship.

M

MFFV. Mobile firefighting vehicle.

MILCON. Military construction.

MLG. Marine logistics group.

MMT. Marine air traffic control mobile team.

MOS. Military occupational specialty.

N

NATOPS. Naval Air Training and Operating Procedures Standardization.





NAVAIR. Naval Air Systems Command.

NAVFAC. Naval facilities command.

NAVFACENGCOM. Naval facilities engineering command.

NAVSUP ENERGY. Naval supply command (Naval Petroleum Office).

NHC. NATO high-capacity HIFR rig.

NSN. National stock number.

NSTM. Naval ships technical manual.

O

OJT. On the job training.

OLF. Outlying landing field.

OSHA. Occupational safety and health administration.

OSS. Operational sequencing system.

P

PASE. Preloaded accessory suspension equipment.

PCS. Portable climate shelter.

PM. Preventive maintenance.

PMS. Planned maintenance system.

POL. Petroleum, oil, and lubricants.

PQS. Personnel qualification standard.

PriFly. Primary flight control (shipboard operations).

PWO. Public works officer.

Q

QAR. Quality assurance representative.

QDC. Quick disconnect coupling.

R

RMC. Regional maintenance center.

S

SIB. Ship's information book.

SOF. Special operations forces.

SOP. Standard operating procedures.

SPR. Single-point pressure refueling.

STANAG. North Atlantic Treaty Organization (NATO) standardization agreement.

SYSCOM. System command.

T

T.O. Technical order (USAF equivalent of NATOPS Manual).

T/O. Table of organization.

TAD. Temporary additional/assigned duty.

TAFDS. Tactical airfield fuel dispensing system.

TAU. Twin agent unit.

TM. Technical manual.

TYCOM. Type commander.





U

UIC. Unit identification code.

USA. United States Army.

USAF. United States Air Force.

USCG. United States Coast Guard.

USMC. United States Marine Corps.

USN. United States Navy.





PREFACE

SCOPE

Naval Air Training and Operating Procedures Standardization (NATOPS) products have been developed to improve aviation safety and readiness throughout the Navy and Marine Corps. They are prepared under the authority of the Chief of Naval Operations and issued by Commander, Naval Air Systems Command to support naval aircraft flight operations. NATOPS Manual (NM) products contain flight clearance information, operating procedures and restrictions necessary for flight crews to effectively operate their aircraft. NMs provide the best available T/M/S aircraft information and operating instructions for most circumstances. Personnel participating in or supporting the aircraft ground refueling evolutions addressed within shall have a thorough knowledge and comply with the requirements of this manual. However, no manual can address every situation completely or be a substitute for sound judgment. Operational situations may require modification of the procedures contained therein.

AIRCRAFT REFUELING NATOPS MANUAL PRODUCTS

See [Chapter 1](#) for (1) the Aircraft Refueling NATOPS Manual permanent flight clearance product set, (2) the Aircraft Refueling NATOPS Manual product set, and (3) the Aircraft Refueling NATOPS Manual program management assignments which include the NATOPS Model Manager, the NATOPS Advisory Group, and the NATOPS Cognizant Command. [Chapter 1](#) also includes other pertinent NATOPS program information unique to aircraft ground refueling operations.

DETERMINING THE CURRENT VERSION OF NATOPS PRODUCTS

Before using this product ensure that you have the latest version by checking the revision, change and interim change information available on the Naval Air Technical Data and Engineering Services Command (NATEC) website at (<https://mynatec.navair.navy.mil>), or on the NAVAIR Airworthiness website at (<https://airworthiness.navair.navy.mil>).

OBTAINING COPIES OF NATOPS PRODUCTS

One-Time Orders.

Copies of this product and the current changes thereto may be ordered online from the Naval Logistics Library (NLL) at <https://nll.ahf.nmci.navy.mil>, or through the naval supply system. It is also available in pdf format on the NATEC website at <https://mynatec.navair.navy.mil> or on the NAVAIR Airworthiness website at <https://airworthiness.navair.navy.mil>.

Note

- When the current revision of a product is ordered through the NLL, all active changes and interim changes (ICs) are shipped with the active revision.
- Quantities of a product ordered in excess of the maximum order quantity posted on the NLL website will not be shipped. If additional quantities are required, contact the NAWC(AD) logistics element manager (LEM) at NATEC tels DSN 735-2425 or CML (619)545-2425 for assistance.
- Active interim changes to NATOPS products are published in electronic media only and are available online at <https://mynatec.navair.navy.mil> and <https://airworthiness.navair.navy.mil>.





Automatic Distribution

NATEC automatically distributes copies of new revisions and changes to users whose NAVAIR product requirements are maintained within its Automatic Distribution Requirements List (ADRL) database. Detailed procedures for establishing and maintaining an ADRL account are contained in NAVAIR technical manual 00-25-100 work package (WP) 017-00, available online at <https://mynatec.navair.navy.mil>.

Note

- When an ADRL account has not been updated within the last 12 months, all automatic distribution for the account will be suspended until it is updated.
- To avoid cost and delivery inefficiencies that result from excessive or insufficient distributions, NATOPS Program Managers are authorized to adjust the automatic distribution quantities of NATOPS products. Units should confirm their requirements with the NATOPS Program Manager in advance of distribution to ensure they receive sufficient quantities.

KEEPING NATOPS PRODUCTS CURRENT

To be effective, NATOPS products must be kept current through an active manual change program. Corrections, additions to, deletions from, and suggestions for improving contents should be submitted as NATOPS change recommendations as soon as possible after discovery. Change recommendations shall be worded as specifically as possible. Detailed standards for NATOPS products are found in MIL-DTL-85025B(AS), available online at <https://airworthiness.navair.navy.mil>. Change recommendations may be submitted by anyone in accordance with CNAF M-3710.7. All users are encouraged to contribute to the currency, accuracy, and usefulness of this and other NATOPS products by submitting timely change recommendations.

THE NATOPS CHANGE RECOMMENDATION PROCESS

Types of Change Recommendations

NATOPS change recommendations are submitted as URGENT, PRIORITY or ROUTINE. URGENT and PRIORITY change recommendations are changes that usually involve safety-of-flight matters and cannot be allowed to wait for implementation until after the next formal review. Some PRIORITY change recommendations may be upgraded to URGENT by NAVAIR (AIR-4.0P), by the NAVAIR Program Class Desk or by the NATOPS Model Manager.

Submitting NATOPS Change Recommendations

The preferred means of submitting all types of NATOPS change recommendations is through the Airworthiness Issues Resolution System (AIRS). AIRS may be accessed online at <https://airworthiness.navair.navy.mil>. AIRS is the fastest and most efficient means of processing and resolving NATOPS change recommendations. It expedites distribution of the URGENT and PRIORITY change recommendations to those who need to act on them and compiles the ROUTINE change recommendations into their respective NATOPS review agenda packages.

In the event that a connection to AIRS is not available, URGENT and PRIORITY change recommendations may be submitted via naval message in accordance with CNAF M-3710.7.

UPDATES TO NATOPS PRODUCTS

Interim Changes

Approved NATOPS urgent and priority change recommendations are issued as ICs via Naval messages and may involve making pen-and-ink entries and/or replacing pages. Copies of IC messages and their replacement pages are posted on the NATEC website at <https://mynatec.navair.navy.mil> and the Airworthiness website at <https://airworthiness.navair.navy.mil>. IC replacement pages are issued in electronic format and are not distributed in paper format except under unusual circumstances. Entry of an IC into a product should be documented on the IC Summary page within the product.





Revisions, Changes and Errata

Routine change recommendations are compiled into an agenda that is held for review at the next formal review of the product. Following the formal review, disposition of the change recommendations is published by the NATOPS Model Manager in a NATOPS review report. Changes requiring immediate entry into the reviewed NATOPS product(s) are posted on the NATEC and Airworthiness websites, and distributed by NAVAIRSYSCOM (AIR-4.0P) in electronic media as an Advance Change IC to the reviewed product(s). A revision or change containing the approved changes to each reviewed product is then prepared and distributed in paper and/or electronic media to those users that have a listed requirement for it in the NATEC ADRL system database. When printing errors are found in products, errata may also be prepared and distributed in electronic or paper form in the same manner as done for revisions and changes. After incorporating a change or errata into a paper product, conduct a page check and record entry of the change or errata on the Record of Changes page within the product.

CHANGE SYMBOLS

Revised text is indicated by a black vertical line in the margin of the page, like the one adjacent to this paragraph. The change symbol shows where there has been material added or information restated. Change symbols are not normally used to mark the locations of deleted information. Change symbols in the margin by the chapter number and title indicate a new or completely revised chapter.

SPECIAL TERMINOLOGY IN NATOPS PRODUCTS

The following special terminology applies to all NATOPS products:

Warnings, Cautions, and Notes

The following definitions apply to WARNINGS, CAUTIONS, and Notes:

WARNING

Explanatory information about an operating procedure, practice, or condition, etc., that may result in injury, death, or loss of aircraft if not carefully observed or followed.

CAUTION

Explanatory information about an operating procedure, practice, or condition, etc., that may result in damage to equipment if not carefully observed or followed.

Note

Explanatory information about an operating procedure, practice, or condition, etc., that must be emphasized.

Requirement for Compliance

“Shall” is used only when application of a procedure is mandatory.

“Should” is used only when application of a procedure is recommended.

“May” and “need not” are used only when application of a procedure is optional.

“Will” indicates futurity and never indicates any degree of requirement for application of a procedure.





Requirement for landing aircraft.

“Land Immediately” means execute a landing without delay.

“Land as Soon as Possible” means land at the first site at which a safe landing can be made.

“Land as Soon as Practicable” means extended flight is not recommended. The landing site and duration of flight are at the discretion of the pilot in command.





PART I

General

[Chapter 1 — Introduction](#)





CHAPTER 1

Introduction

1.1 PURPOSE

This manual provides technical requirements and operating procedures for aviation fuel operations aboard ship, at shore activities, and in tactical units.

1.2 SCOPE

Aviation fuel operations include fuel receipt, short-term storage (usually for a 10-day supply of fuel for a specific activity), transfer, and dispensing to aircraft. This manual applies to all persons involved in aviation fuel operations.

1.3 ORGANIZATION OF THIS PUBLICATION

This manual is divided into 4 parts, 19 chapters, and 5 appendices. **Part I**, which is comprised of **Chapter 1**, is a general section that provides an overview of the manual; **Part II**, which contains **Chapters 2** through **7**, addresses refueling operations aboard ships; **Part III**, which contains **Chapters 8** through **13**, addresses refueling operations at shore activities; and **Part IV**, which contains **Chapters 14** through **19**, addresses refueling operations in tactical units. **Appendix A** contains aviation fuel quality surveillance forms and labels for use by ship, shore and tactical unit personnel in processing fuel samples and reports. **Appendix B** provides deterioration limits for various aviation turbine fuels. **Appendix C** lists recommended subjects for inclusion in a continuous training syllabus for shipboard aviation fuels division personnel. **Appendix D** provides a listing of authorized air station refueling system components. **Appendix E** provides hot refueling procedures in support of special operations missions.

1.4 FLIGHT CLEARANCE PRODUCTS

Airworthiness is the property of an air system configuration that enables it to safely attain, sustain and terminate flight in accordance with the approved usage limits. CNAF M-3710.7 requires that prior to each flight, each naval aircraft, manned or unmanned, shall be certified that it is airworthy. Airworthiness certifications are issued by COMNAVAIRSYSCOM in the form of flight clearances. Permanent flight clearances are issued for standard T/M/S aircraft configurations, missions, and capabilities in the form of NATOPS NFM products, Naval Aviation Technical Information Products (NATIPs), designated Original Equipment Manufacturer (OEM) products, and General Series NATOPS Manuals (NMs). Interim flight clearances are temporary clearances that are issued as stand-alone documents for non-standard aircraft configurations, missions, conditions, aircraft-related equipment and capabilities, or allow deviations from existing flight clearances for specific instances. All current flight clearances may be found on the NAVAIR Airworthiness website, <https://airworthiness.navair.navy.mil>. NAVAIRSYSCOM (AIR-4.0P) is the final authority within the Navy and Marine Corps on airworthiness issues. NAVAIRINST 13034.1-series provides further guidance concerning flight clearances.

This NM contains T/M/S aircraft flight clearance requirements, conditions and information that supplements those in aircraft NATOPS and NATIP product sets.

1.4.1 Flight Clearance Product Set

The flight clearance products set for an aircraft is composed of the applicable NATOPS NFM products, Naval Aviation Technical Information Products (NATIPs), designated Original Equipment Manufacturer (OEM) products, and General Series NATOPS Manuals (NMs). The flight clearance product set for a NATOPS manual is limited to the NATOPS manual and any other derivative products within that set.

1.4.1.1 NATOPS Product Set

The Aircraft Refueling NATOPS product set is comprised of the following product:





NAVAIR 00-80T-109 Aircraft Refueling NATOPS Manual

1.5 AIRCRAFT REFUELING NATOPS PROGRAM MANAGEMENT ASSIGNMENTS

Commands are designated to perform the duties and carry out Aircraft Refueling NATOPS Manual program management responsibilities IAW CNAF M-3710.7 as follows:

1.5.1 NATOPS Model Manager

The Naval Air Systems Command is designated as the NATOPS Model Manager for the Aircraft Refueling Deck NATOPS Manual. Contact information for NAVAIRSYSCOM is as follows:

Message PLAD:	COMNAVAIRSYSCOM PATUXENT RIVER MD//AIR-4.4.5//
Address:	COMMANDER NAVAL AIR SYSTEMS COMMAND AIR-4.4.5 (AIRCRAFT REFUELING NATOPS PRGM MGR) BLDG 2360 22229 ELMER RD PATUXENT RIVER MD 20670-1534
Telephone:	CML (301) 757-3406 DSN 757-3406 FAX (301) 757-3614

1.5.2 NATOPS Advisory Group

NATOPS Advisory Group Member relationships, responsibilities and procedures are contained in CNAF M-3710.7. The following commands are designated as members of the NATOPS Advisory Group for the Aircraft Refueling NATOPS Manual:

NATOPS Advisory Group Member	Representative's Code
Commander, Naval Air Forces	NAVAIRFOR (N433/N7)
Commander, Naval Air Systems Command	NAVAIRSYSCOM (AIR-4.0P/AIR-4.4.5)
Commander, Naval Surface Forces	NAVSURFOR (N42F/N8)
Commandant of the Marine Corps	HQMC (I & L LPE) Fuels Liaison Officer/NAVSUP Energy LNO (070) (703) 767-3695/7354
Deputy Commandant for Aviation	Aviation Expeditionary Enablers Programs (APX) 3000 Marine Corps Pentagon, Room 5D548 (703) 693-9778 DSN: 223
Commander, Marine Corps Installations Command (MCICOM)	G4, Fuels Officer 3000 Marine Corps Pentagon, Room 2D152A (571) 256-7084 DSN: 260
Commander, Marine Corps Systems Command	MARSYSCOM (PMM-115) Engineering Support Equipment, Tactical Fuels Project Officer (703) 432-3595
Commander, Naval Safety Center	NAVSAFECEN (Code 113)
Commander, Naval Surface Warfare Center, Philadelphia Division	NSWCPD (Code 413)
Commander, Naval Facilities Engineering Command	NAVFACENGCOM (Code C111)
Director, Naval Supply Energy Office	NAVSUP Energy Office (Code 70) (703) 767-7330/7333





NATOPS Advisory Group Member	Representative's Code
Director, Marine Corps Bulk Fuel School	Director, Marine Corps Bulk Fuel School (804) 734-2775/2776, DSN 687-
Commander, Marine Aviation Weapons and Tactics Squadron One (MAWTS-1), Aviation Ground Support (AGS) Department Chief	AGS Department Chief (928) 269-7115

1.5.3 NATOPS Cognizant Command

Naval Air Systems Command is designated as the Cognizant Command for the Aircraft Refueling NATOPS Manual program products set.

1.6 CHANGE RECOMMENDATIONS AND QUESTIONS ABOUT AFLOAT SYSTEMS AND PROCEDURES

Questions, problems, and concerns about regarding the technical requirements for afloat systems and their operation and maintenance procedures for aviation and air-capable ships should be directed to the afloat fuel systems life-cycle manager as listed below. Information copies of change recommendations to this manual should also be sent the afloat systems life-cycle manager at:

Message PLAD: NAVSURFWARCENDIV PHILADELPHIA PA//413//
Address: LIFE CYCLE MANAGER
NAVAL SURFACE WARFARE CENTER,
Philadelphia Division (NSWCPD) Code 413
5001 SOUTH BROAD STREET
PHILADELPHIA PA 19112-1403
Tel (CML): 215-897-7948

1.7 RESPONSIBILITIES

1.7.1 Commanding Officers

Commanding officers of Navy Ships, Navy/Marine Corps shore activities, and tactical units that handle aviation fuel are responsible for every aspect of their refueling operations. The commanding officer of each ship or Navy/Marine Corps activity has complete responsibility for aviation fuels aboard their own ship, main activity, and all outlying sites including OLFs, ALFs, helicopter landing areas, etc., from receipt to issue to aircraft. Inherent in the responsibility for fuel are such items as accountability, quality control, safety, handling practices, personnel qualifications, and operational and corrective maintenance of facilities and equipment. Commanding officers of aviation and air-capable ships, shore activities and tactical units shall issue local instructions as necessary to assign responsibilities and provide procedures in sufficient detail to assure the safe and efficient daily conduct of their aviation fuels operations.

1.7.2 Fuel Maintenance/Management Officers (FMO)

The fuel maintenance officer (afloat activities) or fuel management officer (air stations) is responsible to their commanding officer for all aspects of the aviation fuel storage and delivery system from receipt to issue to aircraft. Inherent in this responsibility are such items as accountability, quality control, safety, handling practices, personnel qualifications, and operational and corrective maintenance of facilities and equipment.

1.7.3 Users

Personnel assigned to ships, shore activities, and tactical units are responsible for knowing and complying with the aviation fuels storage and handling requirements contained in this manual.





1.8 LOCAL INSTRUCTIONS

Aviation fuel facilities, equipment and manning vary from ship to ship and shore activity to shore activity. The procedures in this manual are necessarily broad and do not cover all aspects of every activity's operation in detail. To sufficiently clarify the fuel related responsibilities and procedures peculiar to their own activities, facilities and equipment, local activities must supplement this manual with local instructions. To this end, each activity shall maintain an up-to-date fuel handling instruction that supplements this manual and constitutes the activity's authoritative governing document for fuel operations. For ships, the majority of this information is covered in their Aviation Fuel Operation Sequencing System (AFOSS), Operational Sequencing System (OSS) or equivalent. For Government Owned Contractor Operated (GOCO) facilities, this information is covered in the Performance Work Statement (PWS) and contractor detailed plans. The local instruction may refer to information contained in this manual as necessary and shall include, but not be limited to, the following subjects:

1. Fuel organization with functional assignments and duties in detail.
2. Inter- and Intra-departmental responsibilities for fuel, fuel facilities, fuel equipment, and fuel spills.
3. Amplification of this manual's general terms and safety precautions where coverage is too broad for the local situation.
4. Detailed and specific procedures for any unique or peculiar system including any aircraft that require non-standard handling, and for any approved procedures or practices that are in conflict with this manual.
5. Environmental impact and duties associated therewith.

1.8.1 Conflicts With This Manual

Local instructions and practices in direct conflict with the broad base of instruction in this manual require authorization by the Naval Air Systems Command, AIR-4.4.5. Afloat-related conflicts shall also be forwarded to the Naval Surface Warfare Center, Ship's Systems Engineering Station (Code 923) for review.

1.9 CONTINUING REVIEW OF PRACTICES

This manual and supplementing local fuels handling instruction provide the best available operating instructions for most circumstances. However, no manual can cover every situation or be a substitute for sound judgment. Operational situations can easily generate real hazards and severe consequences can result when fuels related mishaps occur. Therefore, personnel assigned to ships, shore activities and tactical units involved in providing retail services shall be continually alert for existing and potential hazards and shall exercise the best principle of risk management during aircraft refueling operations each day.

1.10 WAIVERS

The Model Manager for this manual has the authority to waive requirements in this manual.

Waiver requests that conflict with one or more other NATOPS manuals and/or CNAF M-3710.7 must be routed to CNAF for concurrence. Waivers are typically issued via electronically signed PDF letters. Submit waiver requests to the Model Manager unit listed in [paragraph 1.5.1](#).





1.11 OTHER RELATED PUBLICATIONS

NAVAIR 00-80T-105	CV NATOPS Manual
NAVAIR 00-80T-106	LHA/LHD NATOPS Manual
NAVAIR 00-80T-115	U.S. Marine Corps Expeditionary Airfield and Aircraft Recovery Operations NATOPS Manual
NAVAIR 00-80T-120	CVN Flight/Hangar Deck NATOPS Manual
NAVAIR 00-80T-122	Aircraft Operating Procedures For Air-Capable Ships NATOPS Manual
NAVAIR 00-80T-124	Airfield Operations





PART II

Aircraft Refueling Aboard Ships

Chapter 2 — Organization and Training Aboard Ships

Chapter 3 — Quality Surveillance of Aviation Fuels
Aboard Ships

Chapter 4 — Safety in Shipboard Fuel Handling Operations

Chapter 5 — Shipboard Aircraft Refueling System
and Equipment

Chapter 6 — Shipboard Operating Procedures

Chapter 7 — Shipboard Preventive Maintenance





CHAPTER 2

Organization and Training Aboard Ships

2.1 ORGANIZATION

The effectiveness of any complex operation is dependent on a well-structured organization with qualified and knowledgeable supervision. The cost of fuel, fuel facilities and equipment, and hazards of fuel operations are a few of the critical factors that shall be considered in the development of a fuel organization. It is these factors, coupled with the essential part aircraft refueling plays in flight operations, that justifies "Division" status for the integrated fuel operation.

On aircraft carriers and amphibious assault aviation ships (including LPD Class ships), the Air Officer is responsible for supervising and directing the receipt, stowage, and dispensing of aviation fuels as well as the enforcement of safety precautions and the maintenance and security of the aviation fuels systems. The Aviation Fuels Security Watch onboard CVN's shall be conducted in accordance with NAVAIR 00-80T-120. The Aviation Fuels Security Watch onboard LHA/LHD/LPD class ships shall be conducted in accordance with [Chapter 4](#), 4.10 of the 80T-109. These duties are actually administered by the aviation fuels officer — it is his/her responsibility to ensure compliance with all applicable technical directives concerning the inspection, maintenance, and operation of the aviation fuel system. The deck officer is responsible for the Fueling at Sea (FAS) stations, and the supply officer is responsible for the accountability of the fuel.

The air operations officer, in conjunction with the air department officer/aircraft handling officer, is responsible for establishing priorities for aircraft fuel delivery services.

On air-capable ships, the ship's engineer is responsible to the ship's commanding officer for the aviation fuel system, its maintenance, and operation. Since the system is small and generally services only one helicopter, many of the specific duties are combined and performed by two or three individuals. Nonetheless, air-capable ships must fully comply with all fuel quality surveillance, operational, and maintenance procedures presented in this manual.

2.2 TRAINING REQUIREMENTS

All operations involving the JP-5 system shall be conducted by operators qualified in accordance with the Air Department Aviation Fuels Afloat Personnel Qualification Standard (PQS) NAVEDTRA 43426.4 (series) or for Aviation Fuels Air Capable Ships, less LPD, PQS NAVEDTRA 43149. Aviation Boatswain's Mate Fuels Rating training courses and rating requirements provide shipboard personnel with the skills and knowledge necessary for shipboard fuel handling duties.

2.2.1 Formal Training

Formal training oriented to each ships installed systems equipment is available through CNATTU (9287 7th Ave, Norfolk, VA and NAS North Island, Box 357059, San Diego, CA) in the form of an aviation fuels mobile training team. CNATTU is organized to provide training at the ships homeport/homeyard and should be utilized to the maximum extent possible between ship's deployments and during repair availabilities.

1. EOSS/AFOSS manuals may be used as a training aid.
2. Due to various ship and system configurations, installed firefighting equipment, and local developed procedures, Unit Level Training shall be held in firefighting procedures with particular emphasis on aviation fuel station fire for Flight and Hangar deck, based on command's Hangar Bay Fire Doctrine, and NAVAIR 00-80R-14. JP-5 pump room firefighting procedures shall be held in accordance with Shipboard Damage Control Training based on systems installed and in conjunction with Naval Ships Technical Manual (NSTM) Chapter 555 Vol. 1 and command's Main Space Fire Doctrine.





3. Due to the unique hazards involving aviation fuels handling, a continuous training program in support of PQS shall be implemented in each ship. Guidance on establishing a continuous training program is available from the appropriate TYCOMs. [Appendix C](#) contains a list of subjects that should be part of a ship's aviation fuel division continuous training syllabus.





CHAPTER 3

Quality Surveillance of Aviation Fuels Aboard Ships

3.1 GENERAL REQUIREMENTS

The major objective of fuel handling personnel is to deliver clean, clear, and bright 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. In addition, aircraft engine failure or poor performance may also be caused by incorrect fuel or by contamination of the proper fuel with other petroleum products or materials. Refer to the NAVAIR Aircraft Refueling Handbook (MIL-HDBK-844B(AS)) for a detailed discussion of the various types of fuel contaminants, their effects on the using equipment, and their possible sources.

The quality surveillance of aviation fuels is a continuous process. Every action such as transferring product from one tank to another or short-term storage in a poorly coated tank can introduce contaminants into the fuel. Sources of contamination must be recognized and eliminated or at least minimized. In addition, procedures to routinely monitor the quality of fuel must be in place so that the presence of abnormal amounts of contaminants is identified and steps to remove the contaminants are taken.

The Defense Logistics Agency and its field activity, the Defense Fuel Supply Center, have designated the fuel quality control efforts performed at the refinery or time of fuel purchase as “quality assurance.” All fuel quality control efforts performed after the fuel has been delivered to the government are classified as “quality surveillance.” This chapter conforms to this policy.

This chapter outlines the absolute minimum steps that shall be taken in order to:

1. Monitor the quality of the fuel being handled and delivered to aircraft.
2. Control and minimize the introduction of typical contaminants (water and sediment/particulates).

The detailed operating procedures contained in [Chapter 6](#) and the maintenance procedures referred to in [Chapter 7](#) incorporate many of these monitoring and quality surveillance steps.

3.2 SHIPBOARD AVIATION FUEL QUALITY SURVEILLANCE PROGRAM

All aircraft refueling activities shall establish a formal fuel quality surveillance program. Samples shall be taken from various points in the fuel system such as stripping pumps, purifiers, filter/separators, refueling nozzles, etc., and tested using the Combined Contaminated Fuel Detector (CCFD) and Free-Water Detector (FWD). Fuel sample analysis may also be performed via the automated sampling device (in-line fuel quality sensor). Visual inspections shall also be performed for spot checks. A fuel sample log shall be maintained per [Figure A-6](#); correlation sample logs shall be maintained per [Figures A-3](#) and [A-4](#).

The following paragraphs establish the minimum sampling and testing requirements for aviation fuels. These requirements are the minimum and shall not preclude more frequent or extensive testing should contamination be suspected. The Naval Ship's Technical Manual, Chapter 542, (S9086-SP-STM-010) and Planned Maintenance System (PMS), in addition to the appropriate ship's Operational Sequencing System (OSS) and the Ships Information Book (SIB) shall be consulted for detailed information on handling and sampling aviation fuels aboard ships.

3.2.1 Fuel Received by Ships that Fuel Aircraft

After flow has been established to the receiving ship, a line sample will be taken and checked for:





1. Color.
2. Appearance.

Continue to receive if the product is clear and bright. Immediately take a second sample and test for:

1. API gravity.
2. Flash point.
3. Sediment/particulates.
4. Fuel System Icing Inhibitor (FSII).
5. Water.

Visual samples shall be taken every 15 minutes and inspected for color and appearance. At a minimum, lab samples shall be taken at the beginning, mid-point, and just prior to completion of product transfer.

3.2.2 Fuel Dispensed to Aircraft by Ships

Aircraft refueling nozzles shall be flushed with service fuel (including Helicopter In-Flight Refueling [HIFR] systems) back to the ship's JP-5 storage tanks until clear and bright sample is obtained, prior to initiating the first aircraft refueling of each day from that specific refueling station. Flushing shall be accomplished daily when underway. Fuel samples shall be taken at the refueling nozzle and tested. For those ships equipped with an automated sampling device, flushing shall continue until compliance with NSTM Chapter 542 Table 542-7-1 is displayed and recorded on the shipboard data acquisition system or entered manually by the applicable operator.

1. Appearance.
2. Sediment/particulates (for those ships without the installation of an automated sampling device).
3. Free water, visual or digital (for those ships without the installment of an automated sampling device).
4. FSII content (spot checks only).

Note

A minimum of two samples is required when running both a CCFD and a DFWD test (one for each test) to ensure correct quantity of fuel is available to run both tests. Fuel tested for sediment/particulates, free water, or FSII shall not be reused to run any other test since this practice could lead to inaccurate results.

Nozzle shall not be utilized for fueling aircraft until test results indicate compliance with the use limit requirements. For those ships without the installation of an automated sampling device, additional visual and laboratory samples will then be taken throughout the day and inspected for appearance, visible free water, or sediment/particulates.

Ships' force shall test samples for FSII content upon receipt of fuel from fleet oiler, tanker, or barge, and shall also conduct spot checks at refueling nozzles. The Navy's fuel supply/delivery system can significantly reduce FSII levels by exposure of the fuel to water. Whenever low FSII fuel is encountered, it will be necessary to increase the monitoring of the fuel issued to aircraft (see [paragraph 3.5.5](#)). FSII concentrations in fuel shall be determined using the B/2 Anti-Icing Additive Test Kit.

3.2.3 Routine Correlation Samples and Tests

Each activity shall take a series of routine, duplicate correlation samples to verify in-house testing procedures and equipment are working properly. The results from this sampling/testing program are used by the Type Commanders (TYCOMs) and System Commanders (SYSCOMs) to monitor the general quality of fuel loaded into aircraft.

The exact number of routine duplicate correlation samples drawn, shipped, and tested by each ship depends upon the number of CCFDs and B/2 anti-icing refractometers the activity possesses. As an absolute minimum, each activity





shall draw one set of duplicate samples (two 1-quart bottles) for each CCFD and one set (two 1-quart bottles) for each B/2 anti-icing refractometer. Take and process each duplicate set of samples as follows:

1. Randomly select an aircraft refueling station and delivery hose.
2. Extract two 1-quart samples, one immediately after the other, from the refueling nozzle of the system while it is being recirculated or flushed.
3. Take both samples back to the activity's laboratory.

Note

- If more than one set of duplicate samples is being taken at one time, appropriate steps must be taken to ensure the source of each set of samples can be positively identified.
 - Routine duplicate correlation samples are still required for ships with full or partial automated sampling device installation that still rely on the CCFD as a primary or backup method for sediment/particulate analysis.
4. Test one of the samples, using either the CCFD for sediment/particulates or B/2 for FSII, and record the results in a log (see [Figures A-2](#) and [A-3](#)).
 5. Complete a fuel sample label (see [Figure A-4](#)) and attach it to the second (duplicate) sample. The results obtained using the CCFD or B/2 shall be entered on this label.
 6. Ship the labeled, second (duplicate) sample to a regional fuel testing laboratory (see Appendix B of the MIL-HDBK-844B(AS) for a list of laboratories) for testing of the sediment/particulates (using the ASTM D 2276 or ASTM D 5452 gravimetric method) or FSII as indicated on the sample's label.
 7. When results from the regional laboratory are received, enter them into the appropriate log next to the result obtained using the activity's CCFD or B/2 Test Kit. Compare the two results on the duplicate samples to verify the accuracy of the CCFD or B/2 Test Kit.

3.3 SAMPLING PROCEDURES

Proper sampling of petroleum products is as important to quality surveillance as proper testing. Improper containers and poorly-drawn or mishandled samples can cause laboratory results to be meaningless, or worse, misleading.

Directions for sampling cannot be made explicit enough to cover all cases. Judgment, skill, and experience should supplement any group of instructions. Consequently, the person assigned to take samples shall be trained, experienced, competent, and conscientious. The responsibility for taking and preparing samples shall not be lightly delegated.

This section provides general information on petroleum sampling techniques and practices. For more detailed information and instructions including descriptions of the various types of samples (for example, all-levels, bottom, composite, etc.) consult ASTM Standard Practice D-4057.

3.3.1 General Rules

1. The sampler's hands shall be clean.
2. Sample containers, clear glass quart bottles or LDPE/HDPE plastic bottles, shall be meticulously cleaned (washed with laboratory glassware detergent [Alconox (NSN 7930-01-107-9169), Liquinox (NSN 7930-00-279-7089), Alcojet (NSN 7930-01-326-8099) or Fisherbrand Sparkleen] and water, rinsed with clean water, and oven- or air-dried). Wipe bottles clean with lint-free cloths (i.e., MIL-C-85043 Type II).

Note

Alcohol shall not be used to clean sample bottles.





3. Samples shall be representative of the product being sampled. Samples shall be taken with the system operating at normal flow rates and steady state. Samples drawn during static (no flow) conditions are not representative of the full fuel flow and will give false results.
4. Samples shall be capped promptly, protected from light, and handled expeditiously.
5. Samples taken for shipment to shore laboratories shall be taken only in 1-quart glass sample bottles. Glass sample bottles for shipment to shore laboratories shall be filled to 1 inch below the cap.
6. LDPE/HDPE plastic bottles are authorized for use for the collection of sediment/particulates and free water fuel samples.
7. LDPE/HDPE plastic bottles shall be marked for the appropriate level (800 mL or 500 mL) and filled only to this mark.
8. Samples taken to test filter/separator efficiency shall be taken at the filter discharge.
9. Visual samples shall be taken in clear glass bottles only.

3.3.2 Sample Containers

The following fuel sampling bottles, containers, kits and safety cans are available through the supply system and are the only type authorized for the collection, retention, and submission of aviation fuel samples.

1. Kit, Fuel Sampling. A complete kit consisting of metal shipping container, cushioning material (inner-pack), and four 1-quart sample bottles, NSN 8115-00-719-4111.
2. Cushioning Material. Replacement top/bottom packing material for the above fuel sampling kit, NSN 8115-00-719-4825.
3. Replacement Kit. Replacement bottles and tags for the above fuel sampling kit, NSN 8115-00-717-8572.
4. Drum, Shipping and Storage. A 5-gallon, 24-gauge steel, epoxy-lined fuel sample container suitable for shipment or retention of fuel samples, NSN 8110-00-282-2520.
5. Bottles, Glass, Clear. Twelve 1-quart clear glass bottles (without tags) suitable for taking visual samples and for shipping fuel samples to shore laboratories, NSN 8125-00-378-9994.
6. Bottles, LDPE/HDPE Plastic. Plastic bottles suitable for taking sediment/particulates and free water samples are available in two sizes:
 - a. 1000 mL, NSN 6640-01-300-3541 (6 bottles).
 - b. 500 mL, NSN 6640-01-461-1016 (12 bottles).
7. Container, Safety Can. Containers for the safe storage and transport of used fuel are available in two sizes:
 - a. 1 gallon, NSN 7240-00-177-4999.
 - b. 5 gallon, NSN 7240-00-178-8286.

3.3.3 Identification of Sample

All samples sent to a fuel testing laboratory shall be individually tagged with a label (see [Figure A-4](#)) containing the following minimum information:

1. The originating ship's name, address, and type (CVN, LHA, LPD, FFG, etc.); a point of contact and phone number should be included.
2. Sample serial number (sampling activity's designation assigned to this particular sample) UIC-Julian date-sequential number.
3. End destination point of contact and phone number should be included.
4. Type fuel.





5. Date sample was taken.
6. Approximate time the sample was taken.
7. The source of the sampling point (nozzle sample, filter/separator number, or tank number).
8. Name of the person who drew the sample.
9. Classification of sample and tests required (see [paragraph 3.3.4](#)).
 - a. ROUTINE Correlation (insert CCFD or B/2 results in space provided).
 - or
 - b. SPECIAL (list tests required and/or pertinent remarks. This is especially important when sending in special samples. The comments will assist the laboratory personnel in determining additional tests that should be performed).
10. Identify in the remarks section where the regional laboratory reports are to be distributed. See [paragraph 3.7.5](#). Distribution lists for reports are found in [paragraph 3.7.3](#).
11. Identify the type of sample taken: all level, line tap, bottom etc.

3.3.4 Sample Classification

All samples shipped to a fuel testing laboratory shall be classified either ROUTINE Correlation or SPECIAL.

3.3.4.1 Routine Correlation Sample

Routine correlation samples are the samples taken when no fuel problems or aircraft problems attributable to fuel are known or suspected (see [paragraph 3.2.3](#)). These samples and their test results serve two purposes:

1. Assist the activity in monitoring the performance of their local fuel testing equipment and methods.
2. 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 surveillance equipment (CCFDs and B/2s).

At a minimum, routine correlation samples will be taken and hand delivered to the shore laboratory prior to departure on extended deployment. However, this does not preclude sending correlation samples more frequently if concerns regarding the results obtained with shipboard QS equipment arise.

3.3.4.2 Special Sample

Special samples are submitted for test because the quality of the fuel is suspect either as the result of aircraft malfunctions or for other reasons.

1. Special samples shall have the highest priority in handling, testing, and shipping.
2. Ships submitting special samples shall notify (via message traffic) TYCOMs and the laboratory to which the sample is being sent.

3.3.5 Shipping Instructions

Samples are to be forwarded to appropriate testing laboratories by the most expeditious means. A listing of military petroleum laboratories is included in MIL-HDBK-844B(AS).

Wherever feasible, samples shall be delivered directly to the laboratory by special courier.

Samples to be shipped by military aircraft shall be packed in accordance with the requirements of the manual on Packaging and Handling of Dangerous Materials for Transportation by Military Aircraft (AFM 71-4/TM 38-250/NAVWEPS 15-03-500/MCO P4030.19). The sampling kit listed in [paragraph 3.3.2](#) above meets these requirements.



**WARNING**

New sample bottle caps shall be used for all samples being shipped in this sample kit. Bottle caps (NSN 8125-01-422-4509 QTY. 100).

3.4 FUEL LABORATORY, TEST EQUIPMENT, AND METHODS

3.4.1 Laboratory

Each activity that refuels aircraft shall have a designated laboratory where the in-house inspections and tests can be performed in a clean, safe environment that meets Naval Ships Technical Manual and General Specifications for Overhaul (GSO). As an absolute minimum, the laboratory must have a properly ventilated fireproof hood in which the test equipment can be permanently set up and operated. The only exception to this requirement is on older, small air capable ships. For these ships, a specific area with good ventilation where the testing equipment can be stored and conveniently set up and operated on a moment's notice must be designated.

3.4.2 Testing Equipment

Each activity that refuels aircraft shall maintain a laboratory with the following equipment:

1. Combined Contaminated Fuel Detector (CCFD). This instrument is used to analyze the sediment/particulate contamination in a sample of fuel. Currently, the only CFD being procured is the Combined Contaminated Fuel Detector (CCFD), NSN 6640-01-013-5279, which includes an obsolete built-in FWD Viewer Kit. The regular CFD, NSN 6630-00-706-2302, is still available and may be used. The DFWD from item 3 is available as a standalone device to be used for free water testing. Future CCFD models with a built-in DFWD may be available. Additional materials needed to conduct tests are:
 - a. Filter Element, Fluid, 0.65 micron — NSN 6640-00-967-0500.
 - b. Filter, Wratten — NSN 6630-00-849-5288.
2. Digital Free Water Detector (DFWD), ASTM D3240 (NSN 6640-01-642-9285). This instrument is used to determine the free-water content of aviation fuels. Additional materials needed to conduct tests:
 - a. Detector Pad, Free Water (25 mm), 50 count, NSN 6640-00-235-3820.
 - b. Detector Pad Holder (25 mm), NSN 6665-01-642-9295.
3. Manufacturer calibration of NSN 6640-01-642-9285 shall be required by either the following:
 - a. The reported value is outside of the shuttle calibration standard range.
 - b. Within twelve months of manufacturers expiration date supplied with each unit.

Note

A CCFD and DFWD are still required for ships with full or partial automated sampling device installation that still rely on this equipment as a primary or backup method for sediment/particulate and free water analysis.

4. The following devices are used to determine the FSII content of aviation fuels.
 - a. B/2 Anti-Icing Test Kit or Fuel System Icing Inhibitor (FSII) Refractometer, NSN 6630-01-165-7133.
 - b. Gammon HB/2D Digital Refractometer, NSN 6650-01-633-0096.
 - c. MISCO PA202 Digital Refractometer, NSN 6650-01-615-4842.
5. API Thermo-Hydrometers and a 1000-mL clear, plastic, or glass graduated cylinder NSN. These should be used to determine the specific API gravity of the fuel.
 - a. Thermo-Hydrometer, Graduate 29 to 41° range, JP-5/8, non-mercury filled, NSN 6630-00-242-9258.





- b. Thermo-Hydrometer, Graduate 39 to 51° range, JP-5/8, non-mercury filled, NSN 6630-00-245-8376.
 - c. Anton Parr DMA 35 digital density meter, NSN 6635-01-576-2591.
6. Flash Point Test Equipment. This equipment is used to determine the flash point of a fuel sample. It is absolutely essential that all activities possess one of the following instruments, since any fuel removed from an aircraft and destined for storage must have its flash point tested in order to determine its disposition.
- a. Pensky-Martens closed cup flash point tester, NSN 6630-00-530-0987. (This equipment requires use of a propane cylinder.)
 - b. Electronic flash point tester (NAVIFLASH), NSN 6625-01-472-6783. (Requires N-Dodecane for calibration.)
 - c. N-Dodecane Calibration Standard, NSN 6810-01-419-2677 (for use with electronic flashpoint tester).

3.4.3 Test Methods

Instructions for performing the appearance or visual test, the backbone of any fuel quality surveillance program, are contained in [paragraph 3.5.2](#). Specific instructions are contained in the operating manuals provided with each test instrument at the time of procurement. Replacement copies of these manuals may be obtained from NAVAIR AIR-4.4.5.

3.5 INTERPRETATION OF TEST RESULTS

For ships without an automated sampling device, aviation fuel must be clear and bright and contain no visually detectable free water in order to be acceptable for delivery to aircraft. For ships equipped with an automated sampling device, an alert/alarm on the control console will inform the operator of a sample exceeding fuel quality limitations.

WARNING

Personnel fueling aircraft shall cease fueling operations immediately upon detecting any departure from acceptable criteria and inform the pilot, maintenance officer, or other designated person in charge as to the condition of the fuel delivered.

When off-specification fuel is identified, the source of fuel will be placed out-of-service pending investigation and any corrective action that may result. The pilot, maintenance officer, or other person in charge, when notified that doubtful or contaminated fuel has been delivered to an aircraft, will take action to determine whether the aircraft should be defueled and cleaned.

3.5.1 Test Results Action

If lab results, sampling at aircraft fueling points, or three consecutive automated sampling device readings do not meet water or sediment use limits, stop delivery of fuel to aircraft from suspected segment until the problem is corrected.

1. Resample suspected fueling nozzles and filter outlets. Deliver these samples to the quality surveillance laboratory for immediate analysis. Resamples of reported contamination shall include the marking: Resample.
2. Refueling may continue while awaiting lab resample results if on board resamples meet deterioration use limits.
3. If resampling confirms the existence of unacceptable fuel, isolate contaminated section until problem is corrected.





3.5.2 Appearance (Visual Test)

The test shall be conducted using a round, transparent, glass bottle, 1 quart in size. The bottle shall be clean. The sample is first visually inspected for color and presence of foreign matter. The sample shall then be swirled to form a vortex. Particles coarse enough to settle will collect as sediment/particulates on the bottom of the bottle directly beneath the vortex.

A passing sample shall be “clear and bright,” which means free of any cloud, emulsion, or readily visible sediment/particulate matter or free water. The color should be clear and colorless to straw-yellow. When any appreciable contamination is found, the test shall be repeated, paying particular attention to cleaning and rinsing the container prior to sampling. Also, if there is any question as to the quality of the fuel, both sediment/particulate and water measurements must be made using the CCFD and the FWD.

Note

For system locations where an automated sampling device is installed, manual visual samples are not required, except for filter discharge samples prior to opening the filter discharge valve. Real-time fuel quality output at the specific location is displayed and recorded on the shipboard data acquisition system or manually entered by the applicable operator. Manual visual samples may be used as a back-up to the automated sampling device, where the situation dictates. Manual visual samples are required where the in-line quality sensor is not installed.

3.5.3 Sediment/Particulates

Solid contaminants (rust and dirt) can be held well below a level of 1 milligram per liter (mg/L) in a properly functioning fuel distribution system. If solid contaminants in fuel at aircraft dispensing points exceed 1 mg/L, notify Aviation Fuels Officer, investigate, and take corrective action to improve fuel quality.

WARNING

If solid contaminants exceed 2 mg/liter, delivery of fuel to aircraft shall be stopped and corrective measures completed prior to resumption of fueling operations. Loading of aircraft with fuel containing excessive contamination can result in a malfunction of the engine or fuel system and subsequent loss of aircraft, pilot, and crew.

3.5.4 Free Water

A satisfactorily performing filter/separator will provide fuel containing less than 10 parts per million (ppm) of free water. Should the level of free water in fuel at an aircraft dispensing point exceed 10 ppm, report results to Fuel Maintenance Officer/Chief. A second sample will be taken immediately to ascertain if the second sample confirms that the free water exceeds 10 ppm. If so, fueling shall be stopped until changes in procedure and equipment that reduce the free water to 10 ppm or below are effected.

CAUTION

During the receipt of fuel into a storage tank, if the other tests are satisfactory but the sediment/particulate and/or free-water contamination is high (above 2 mg/liter of sediment/particulate contamination or 10 ppm of free water), extra testing and surveillance shall be conducted downstream to assure that this contamination is reduced by settling and filtration to acceptable levels before dispensing to aircraft.





3.5.5 FSII

FSII performs two important functions that help to avert significant safety-of-flight problems. First, it prevents the formation of water-ice in aircraft fuel systems, which can occur in certain susceptible aircraft. Second, FSII acts as a biostat preventing the growth of various microorganisms that can contaminate fuel systems (shipboard aviation systems as well as aircraft), block filters, and promote corrosion.

The minimum level of FSII in fuel for USN/USMC aircraft requiring FSII to prevent water-ice formation is 0.03 percent. The minimum level of FSII in aviation turbine fuel for other US services' is 0.04 percent. The minimum level of FSII in aviation turbine fuel for foreign aircraft is 0.07 percent.

CVNs and air-capable ships have no means of raising the FSII level of their JP-5. FSII materials are mutagenic and considered to be dangerous in the neat state; however, they are safe once blended into the fuel. Shipboard injection of FSII is not approved. Refer to MIL-HDBK-844B(AS) for guidance on raising FSII level by commingling fuel between tanks.

If the FSII level falls below the 0.03 percent limit, the Fuels Maintenance Officer shall notify the appropriate Navy or Marine Corps squadron Commanding Officer (CO) or his/her designated representative, via the Air Officer. The applicable NATOPS Aircraft Flight Manual shall be consulted by the pilots for operating instructions, which will avoid resultant safety-of-flight problems.

Transient (USAF, USA, and visiting foreign military aircraft) crew members and pilots will be notified of low FSII (levels of 0.07 percent or less) so that they may consult their appropriate technical directives for special operating instructions necessary to avoid water-ice induced problems.

WARNING

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

Note

The B/2 Anti-Icing Test Kit Refractometer contains two FSII scales; one for each of the two different FSII materials currently in use. All JP-5 fuel tested shall be assumed to contain the high flash point type of FSII material, Diethylene Glycol Monomethyl Ether, or DiEGME, which is read from the scale on the B/2 refractometer marked "JP-5" or "M." Newer models of the B/2 refractometer may be only marked "DiEGME."

3.5.6 Other Test Results

The results of all other tests shall be evaluated by comparison with the limits described in [Appendix B](#), which contain the Deterioration Use Limits for Aviation Fuels. The limits in [Appendix B](#) refer specifically to the acceptability of aircraft fuels for delivery to aircraft. The particular ship from which the fuel is being removed and the one into which it is being loaded must be considered when applying these use limits; a limit on free water of 10 ppm maximum or 2 mg/liter on sediment/particulates may not be applicable to a sample from a large shipment if subsequent cleanup in the fuel handling system can be anticipated.

Any activity that suspects either chemical contamination, deterioration during storage, or other unusual contamination or condition shall send fuel samples to an appropriate regional fuel laboratory (see list in [Appendix B](#) of MIL-HDBK-844B(AS)) for testing. Samples must be clearly labeled as discussed under identification of sample with information about the suspected problem included in the remarks section.

Inquiries pertaining to the quality or testing of aviation fuels and lubricants shall be addressed to COMNAVAIRSYSCOM (AIR-4.4.5), with a copy to the NAVSUP Energy Office.





3.5.7 Routine Correlation Samples

Compare test results obtained by the activity's in-house laboratory with those obtained by a regional fuel laboratory on the duplicate sample. (See [paragraphs 3.2.3](#) and [3.3.4.1](#).) Some variation between the two test results is expected because of errors introduced by the shipment and storage of the duplicate fuel sample and differences in the test techniques. No action is necessary unless differences between the two results are greater than 0.8 mg/L. If this happens, recalibrate the CCFD following PMS, review the testing procedure, and submit and test more duplicate correlation samples. If results are still out of the acceptable range of differences, contact NAVAIR AIR-4.4.5 for further guidance.

The results of the FSII correlation sample tests should also be compared. Variation by as much as 0.03 percentage points is considered acceptable. If greater differences are noted, review the procedure, recalibrate the instrument, and take additional correlation samples and test them. If results are still out of the acceptable range, contact NAVAIR AIR-4.4.5. It may be necessary to procure a new refractometer.

3.6 GUIDELINES FOR REQUESTING REGIONAL LABORATORY SERVICES

1. Samples shall be forwarded to a Navy laboratory if practicable. See Appendix B of MIL-HDBK-844B(AS) for a list of laboratories.
2. Decisions as to which laboratory to utilize shall be based upon laboratory proximity, capabilities, and workload if known.

Note

Not all laboratories are available for regular recurrent testing on a no cost basis.

3.7 REGIONAL LABORATORY TEST METHODS AND REPORTING

The following paragraphs provide instructions to regional labs that receive samples from ships.

3.7.1 Routine Samples

Laboratories receiving samples for routine fuel quality checks shall test the samples as requested on the sample label for one of the following properties using the listed American Society of Testing Materials (ASTM) method:

1. Sediment/Particulates, ASTM D 2276.
2. FSII content, ASTM D 5006.
3. Flash point, ASTM D 93 or D 6450.

Laboratories shall also note the presence of significant amounts of free water in the bottom of the sample container. Laboratories shall not run free-water determinations on routine samples since the free-water content of the fuel is severely affected by normal shipping and handling of the sample and results are meaningless.

Note

All JP-5 fuel tested shall be assumed to contain Diethylene Glycol Monomethyl Ether.

3.7.2 Special Samples

Laboratories receiving special samples for testing shall conduct requested tests in accordance with methods authorized by the applicable fuel specification.

3.7.3 Reporting

Laboratories performing testing shall report the results to the following:

1. Original — Commanding officer of ship submitting sample





2. One copy each — (All aviation fuel test reports)

a. Commander
Naval Air Systems Command (AIR-4.4.5) 22229 Elmer Rd., Unit 4
NAS Patuxent River
Patuxent River, MD 20670

b. Commander
Naval Air Forces U.S. Atlantic Fleet
Code N433E2
1279 Franklin St Bldg V-88
Naval Station Norfolk, VA 23511-5188

or

Commander
Naval Air Forces U.S. Pacific Fleet
Code N4333
Naval Air Station, North Island
San Diego, CA 92135-5100

c. Commanding Officer
NAVSUP Energy Office
8725 John J. Kingman Rd.
Suite 3719
Fort Belvoir, VA 22060-6224

d. Commander
Naval Sea Systems Command
SEA-03L
2531 Jefferson Davis Highway
Arlington, VA 22242-5160
(Amphibious/air-capable ship fuel reports only)

e. Commander
Naval Surface Forces U.S. Atlantic Fleet
Code N421A
Norfolk, VA 23511-6292

or

Commander
Naval Surface Forces U.S. Pacific Fleet
Code N42
2841 Rendova Road
San Diego, CA 92155-5490

3.7.4 Report Forms

Regional laboratories are requested to report results on a form similar to [Figure A-5](#) in [Appendix A](#). It is essential that the CCFD and B/2 results reported by the sampling activity on the sample's label be included along with the results obtained by the regional laboratory.

3.7.5 Distribution Lists for Reports

It is the responsibility of the activity submitting samples to a laboratory to provide the laboratory with the desired distribution of reports in accordance with [paragraph 3.7.3](#) above.





3.7.6 Message Reports

Message reports are mandatory for the following:

1. "Special" fuel samples.
2. "Routine monthly correlation samples" that exceed the use limits for sediment/particulates or when FSII content is below 0.03 volume percent.

3.8 PROCEDURES FOR PREVENTING AND CONTROLLING CONTAMINATION

Contamination of aviation fuel can be prevented only by the use of proper equipment and by carefully following proper operating procedures. Aviation fuel handling systems shall be used by all aircraft refueling activities to contain and process the fuel immediately prior to issue to aircraft.

On board ships, the fuel handling system employs special centrifugal purifiers and/or multiple filter/separator systems to clean and dry the fuel prior to its being loaded onto aircraft. It is essential that service and storage tank stripping procedures and schedules be followed to remove free water and sediment/particulates from the fuel.

The proper care, operation, and maintenance of these systems are essential in assuring that only clean, dry fuel enters aircraft. As a minimum, operators shall:

1. Observe and record the pressure drops daily across all filter/separators in order to detect failures or problems or as OSS and PMS directs.
2. Take every precaution possible to prevent the introduction of any sediment/particulate matter (dirt) into the fuel (see discussion in MIL-HDBK-844B(AS)).
3. Install and maintain dust-tight caps or covers on all openings and connections, including refueling nozzles. These caps shall be removed only when item or system is in use. Dust caps on Gammon fittings are not to be used aboard ship.
4. Before removing cover, brush away or remove any accumulated dirt or sand around fill covers, manholes, and other covered openings.
5. Never leave any fuel tank or other vessel open to the air any longer than absolutely necessary.
6. Do not operate any fuel handling equipment unless all filters, strainers, screens, and nozzle spout caps are properly installed and in place.
7. Never remove any filter, strainer, or screen for any purpose, except for cleaning or maintenance. Always replace filter or screen immediately after cleaning in accordance with PMS.
8. Observe and report any unusual operating condition, for example, if the refueling nozzle screen requires an unusual amount of cleaning.
9. Observe water that is drained from filter/separator sumps and report any accumulation of foreign matter.
10. Flush or recirculate product in refueling system to remove condensate and sediment/particulate contaminants from lines, hoses and nozzles prior to aircraft issues. This is mandatory for any refueling equipment that has not been in use for a period of time exceeding 24 hours or any portion of the system used to deliver fuel to aircraft which has been opened for maintenance or repair. Minimum circulation time must be determined locally for each piece of equipment depending on its configuration and size as well as fuel flow rate. Allow sufficient time for the fuel in the piping and hose(s) downstream of the fuel filter to be completely replaced by clean, dry fuel.

Note

Any refueling hose that has been used to defuel an aircraft must be flushed with clean, dry fuel. Fueling shall not begin until acceptable results have been obtained (i.e., 2 mg/L of sediment/particulate and 10 ppm of free water or less).





11. Ensure regularly scheduled maintenance is properly performed.
12. Report and investigate any suspected contamination or irregularity detected.
13. Report and correct any leaking valves, lines, or connections.
14. A hose assembly that has been subjected to abuse, such as severe end pull, flattening or crushing by a vehicle, or sharp bending or kinking, shall be removed from service and inspected in accordance with PMS.





CHAPTER 4

Safety in Shipboard Fuel Handling Operations

4.1 INTRODUCTION

The focus of this chapter is safety. The fuel quality surveillance procedures of [Chapter 3](#), the facilities and equipment requirements of [Chapter 5](#), the operating procedures of [Chapter 6](#), maintenance requirements of [Chapter 7](#), and MIL-HDBK-844B(AS), were all developed and established with safety as a primary goal. This chapter contains specific safety procedures and requirements that are either general in nature and therefore not covered in other chapters of this manual or are extremely important and repeated here for emphasis.

Although the procedures and requirements contained in this manual are as complete as possible, they are no substitute for a thorough knowledge of aviation fuels and their inherent characteristics and dangers. All aviation fuels personnel shall therefore be completely familiar with the information contained in MIL-HDBK-844B(AS). As refueling personnel master a knowledge of aviation refueling, they will be better able to avoid and correct unsafe situations.

WARNING

Any departure from the procedures of this manual may adversely affect the overall safety of the operation being performed.

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 is the investigation of field accidents or problems. Therefore, it is extremely important that knowledgeable personnel be involved in accident investigations, especially whenever explosions or fires have occurred. Activities shall therefore request the assistance and participation of experts whenever major fuel accidents are being investigated to ensure correct conclusions are drawn. NAVSEA, NAVAIR, and TYCOM will assist in the identification of appropriate experts for specific investigations.

WARNING

Always assume that fuel vapors (in a tank, above a pool of fuel, etc.) are in the flammable range (i.e., proper fuel-air mixture to ignite).

4.2 SPECIAL SHIPBOARD SAFETY PRECAUTIONS

In addition to the general safety precautions contained in this chapter, the unique nature of the shipboard environment warrants a few specialized safeguards.

1. All fuel movement shall be secured during emergencies such as fire or flooding.
2. Lighted cigarettes, exposed flames, or heat producing devices of any kind shall not be permitted in the vicinity of open tanks, pipes, hose couplings, or containers carrying aviation fuel.
3. The smoking lamp shall be out in the vicinity of the aircraft during fueling or defueling operations.





4. Every effort should be made to minimize the number of personnel in the vicinity of aircraft during fuel operation.
5. During all fueling operations the use of fueling signals/signal wands is mandatory by fuel crew personnel.
6. Fueling or defueling of an aircraft supported by jacks is strictly prohibited.
7. Simultaneous fueling, loading, and downloading of weapons to include preloaded IMERS/ITERS and "PASE" weapons and installation of fuzes and arming wires is authorized with the following warnings adhered to:

WARNING

- Loading/downloading and oxygen servicing, other than converter replacement at the aircraft, shall be conducted as separate evolutions.
 - Refueling hoses shall not be connected to an aircraft which is undergoing loading/downloading of specific forward firing weapons (i.e. AIM-9, AIM-7) that require electrical connections to make contact during the loading/downloading evolution. Refueling hoses shall never be positioned under weapons being loaded/downloaded.
 - No electrical connections between the aircraft and weapons or removal/installation of impulse cartridge shall be accomplished while fueling of the aircraft is in progress.
 - When electrical storms are within a 5-nautical mile radius of the ship, all refueling/defueling evolutions shall cease until the condition clears the 5-mile radius.
8. When fueling or defueling aircraft, a PQS qualified member of the Aviation Fuels Division shall be present to ensure all operations are conducted per applicable instructions.
 9. When the JP-5 system is to be operated, the Aviation Fuels Officer, the Aviation Fuels CPO or PQS qualified supervisor shall be present and in direct charge. He is responsible to see that all personnel comply with all existing instructions and directives and that all necessary safety precautions are strictly adhered to and that all communications are established and operable prior to operation of the system.
 10. Firefighting equipment shall be operational prior to refueling/defueling in the hangar deck.
 11. Approved Emergency Air Devices shall be provided for each manned space (number required is subject to maximum manning level per space, i.e., one per person).
 12. Grounding wires for personnel shall be serialized and inventoried daily at sea to minimize the possibility of Foreign Object Damage (FOD).

4.3 ELIMINATING SOURCES OF IGNITION

4.3.1 Reducing Electrostatic Charges

WARNING

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

One of the primary sources of ignition is static electricity. To ensure the safe relaxation of static charges relevant to fuel operations, all units shall:





1. Refill filter/separator vessels slowly, whenever they have been drained.
2. Always electrically ground from the deck to the aircraft in accordance with MIL-HDBK-274(AS).
3. Bond over-the-wing (gravity) refueling nozzles to the aircraft using a separate bonding pig-tail before tank's caps are removed.
4. Inspect bonding and grounding cables, clamps, and plugs on a daily basis or in accordance with PMS.
5. Secure all external fueling evolutions when electrical storms are within a vicinity of five miles.

4.3.2 Eliminating Other Sources of Ignition

To prevent or eliminate sources of ignition, activities shall observe the following:

1. Before attempting to fuel aircraft, attach grounding wire connection to discharge static electricity. Attach the ground wire to the deck before attaching to the aircraft.
2. Do not introduce portable lights except safety lights into any compartment or space where fuel or flammable vapors may be present. (API has determined that ordinary commercial two- and three-cell flashlights, using carbon zinc dry cell batteries, may be safely used around flammable fuel/air mixtures. Tests have proven them incapable of igniting vapors, even if accidentally dropped or when the light bulb is crushed.)
3. Do not allow fuel personnel to carry matches or cigarette lighters in pockets.
4. Be certain oxygen servicing other than converter replacement at the aircraft and fueling are conducted as separate evolutions.
5. Conduct gravity (over-the-wing) refueling only if the aircraft is solely configured for gravity fill operations.
6. Hold hot refueling operations to the absolute minimum possible and then only in accordance with specific aircraft NATOPS guidance.

4.4 REDUCING OR CONTROLLING VAPOR GENERATION

In order to help prevent fires by reducing or controlling vapor generation, units shall:

1. Handle fuel in approved containers only.
2. Keep all fuel containers, such as aircraft fuel tanks or vessels, closed except when necessary to open for actual operation.
3. Avoid spilling fuel during fuel handling operations.
4. Take immediate action to clean up any spill that occurs. Wipe or absorb small spills with rags or adsorbents. Follow local emergency procedures for large spills.
5. Dispose of oily waste or rags immediately after using by placing in self-closing metal containers.
6. Report all leaks in any portion of the fuel handling system.
7. Treat empty or apparently empty cans or containers that formerly held aircraft fuels as though they still contain fuel. These containers still contain vapors and are dangerous for many days after they have been emptied.
8. Be aware that fuel vapors are heavier than air and will collect in low places.
9. Never dispose of fuel in deck drains, laboratory deep sinks, or sanitary sewage systems/Contaminated Holding Tanks (CHTs).

4.5 MISCELLANEOUS SAFETY PROCEDURES

All units shall:





1. Use all fire extinguishers only for their intended purpose, that is, to extinguish fires. They shall never be used to inert a fuel tank.
2. Keep all equipment and work areas neat, clean, orderly, and in good mechanical condition.
3. Ensure firefighting equipment and extinguishers are in good condition and readily available.
4. Never use gasoline as a cleaning agent.
5. Do not refuel aircraft with demonstrated unreliable fuel vent or dump systems over hot catapults.

4.6 EXTINGUISHING FIRES

Although the ship's crash crew has prime 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 firefighting equipment is readily available whenever and wherever fuel handling operations are being conducted. For maximum effectiveness and safety, fire extinguishers must be operated in accordance with the specific procedures developed for each individual type. MIL-HDBK-844B(AS) contains a special section on fire extinguishment, which has been extracted from NAVAIR 00-80R-14, U.S. Navy Firefighting and Rescue NATOPS Manual. All refueling personnel shall be thoroughly familiar with this basic information.

4.7 MINIMIZING HEALTH HAZARDS

Aviation fuels must be handled with caution because of the obvious dangers associated with possible fires and/or explosions, and because these materials themselves present a danger to the health of fuel handling personnel. These dangers are equally important as those of fires and explosions even though they are not so well known. MIL-HDBK-844B(AS) contains a detailed discussion of the health hazards of aviation fuels.

In order to minimize the health dangers, fuel handling personnel shall:

1. Never enter tanks and voids where fuel vapors are present, without permission of the commanding officer.
2. Keep to an absolute minimum the amount of time spent breathing fuel vapors. Good ventilation of work spaces is mandatory.
3. Stay on the windward, or upwind, side of the spill when it is necessary to remain in an area where a large spill has occurred.
4. Stop the fuel handling operation and move to a fresh air location immediately if dizziness or nausea occurs.
5. Avoid skin contact with liquid fuels and tank water bottom that can contain a high concentration of FSII. If fuel or water bottoms does contact the skin, wash with soap and water immediately.
6. Never wash hands with gasoline or jet engine fuels.
7. Remove fuel-soaked clothing or shoes at once.
8. Wear cranial, goggles, gloves, and clothing that leaves the minimum amount of skin exposed during refueling/defueling operations. This practice will minimize burns in a fire.
9. Use only footwear that completely covers the feet in order to provide protection against fuel spills and fires. Shoes made of fabric or other absorbent materials are not acceptable.

4.8 UNIFORMS

4.8.1 Flight Deck Uniforms

A complete flight deck uniform shall consist of approved flight deck trousers, flight deck jersey, flotation device, authorized steel-toe boots, leather gloves, helmet with goggles and jersey corresponding in color to that of their respective detail and with their billet title on the jersey and flotation vest. Coveralls are not authorized to be worn on the flight deck at any time while flight deck operations are being conducted. Personnel assigned specific duties shall wear the appropriate flight deck gear.





4.8.2 Hangar Deck Uniforms

A complete hangar deck uniform shall consist of approved flight deck trousers, flight deck jersey, authorized steel-toe boots, leather gloves, helmet with goggles and jersey corresponding in color to that of their respective detail and with their billet title on the jersey.

4.9 CONFINED SPACES

Personnel entering or working in or around confined spaces exposed to fuels and fuel vapors may encounter potential hazards. For definitive information regarding the hazards of confined spaces, hazardous environments, and gas-free engineering consult NAVSEA S6470-AA-SAF-010, U.S. Navy Gas-Free Engineering Program Technical Manual. All personnel shall comply with the Navy policies and procedures specified in this gas-free engineering manual.

4.10 AVIATION FUELS SECURITY WATCH

4.10.1 Basic Function

The Aviation Fuels Security Watch shall be stood by qualified Aviation Fuels Security Watch personnel under the supervision of the Duty AVFUELS Petty Officer (LHA/LHD) or central control (LPD). All watch standers shall be PQS-qualified under the AVFUELS (Afloat) PQS. This one-person watch shall be posted as prescribed below and maintain communication with the AVFUELS POOW (LHA/LHD), or central control (LPD) using a two-way radio. AVFUELS watch stander under instruction (UI) shall be assigned under the supervision of a PQS-qualified watch stander. The watch shall be posted and properly relieved by the AVFUELS POOW (LHA/LHD) or within central control (LPD). The Aviation Fuels Officer is responsible for setting the aviation fuels watch. Logs shall be reviewed daily and maintained for a period of 6 months.

Note

Qualified AVFUELS Security Watch personnel not outfitted with two-way radios shall continue to make two-person rounds every 2 hours.

4.10.2 Fuels Watch

1. In port, during normal working hours, system not under pressure:
 - a. Duty Section Supervisor shall make one round and report condition to the LCPO.
2. In port, during nonworking hours, system not under pressure:
 - a. AVFUELS Watch roving patrols shall inspect pump rooms, flight and hangar deck fueling stations and MOGAS stowage area (when carried onboard) making one round every 2 hours and report the AVFUELS POOW (LHA/LHD), or Central Control (LPD).
 - b. If filter(s) has been drained, eliminate it from the watch.
 - c. On LPDs, if any other ship's watch that will integrate inspecting aviation fuel spaces, those sailors will not only be AVFUELS PQS qualified but there will be an Air Department Fuels Supervisor within the duty section to diagnose and fix any issues encountered.
3. At anchor, with system pressurized:
 - a. AVFUELS Watch roving patrols shall inspect flight and hangar deck fueling stations, pump and filter rooms, and MOGAS stowage area (when carried onboard), one round every 2 hours, and report to the AVFUELS POOW (LHA/LHD) or Central Control (LPD).
4. Underway, at flight quarters:
 - a. Below deck supervisor or his assistant shall inspect hangar bay fueling stations and MOGAS stowage area (when carried onboard) and unmanned below deck spaces twice per day/night shift and report conditions to the AVFUELS LCPO/Maintenance CPO (LHA/LHD) or Air LCPO (LPD).
5. Underway, not at flight quarters:





- a. Flight Deck AVFUELS Supervisor or assistant shall inspect flight and hangar deck fueling stations and MOGAS stowage area (when carried onboard) twice per day/night shift.
- b. Below Decks Supervisor or assistant shall inspect unmanned below deck spaces twice per day/night shift. Both supervisors shall report conditions to the AVFUELS LCPO/Maintenance CPO (LHA/LHD) or Air LCPO (LPD).

4.10.3 Duties, Responsibilities, and Authority

The Aviation Fuels Roving Security Watches shall:

1. Inspect each space or station for the following:
 - a. Security of valves.
 - b. Leaks.
 - c. Gear adrift.
 - d. Unauthorized personnel.
 - e. Proper ventilation.
 - f. Lighting.
 - g. Excessive liquid in the bilge of each pump room.
 - h. Unauthorized smoking, open flames, or unauthorized welding in or around the aviation fuels system without proper authority and firefighting equipment.
2. Report the conditions of the AVFUELS system at the completion of each round to:
 - a. The OOD, if the ship is in port with no air wing embarked.
 - b. The Integrity Watch Officer, in Flight Deck Control, when the air wing is embarked.
3. Report all fires to the OOD immediately, giving class of fire, compartment number and name of space, frame number, reporter's name, and the number from which he/she is calling.

Note

In the event of a fire, the AVFUELS Petty Officer shall ensure that the aviation fuels system is secured and shall inform the on-scene leader of the affected areas and system components in the fire area.

4. Report to the Duty AVFUELS Petty Officer (LHA/LHD) or central control (LPD) if any discrepancy is noted.
5. Perform such other duties as may be assigned.





CHAPTER 5

Shipboard Aircraft Refueling System and Equipment

5.1 GENERAL REQUIREMENTS

This chapter describes the basic requirements for aviation fuel handling equipment for ships that fuel aircraft. Shipboard systems are designed and constructed in accordance with the applicable NAVSEA ship design specification.

WARNING

Any departure from the minimum equipment/facilities requirements established in this manual may adversely affect aircraft safety-of-flight as well as the safety of fuel handling operations.

5.1.1 Filtration Requirements

All ships or activities that refuel aircraft shall process the fuel issued to aircraft through an absolute minimum of two fuel cleaning or filtration devices before loading the aircraft.

5.1.2 Maximum Refueling Pressure

All aircraft pressure refueling systems must be designed to limit the maximum pressure at the aircraft's adapter (downstream side of the nozzle) to 55 psi (steady-state, including deadhead, no-flow conditions). During refueling operation an aircraft's individual fuel tank internal fuel shut-off valve closes, creating dynamic, high frequency, short duration pressure surges within the aircraft's refueling manifold. The pressure control device on every refueling system must react quickly enough to limit this surge pressure to 120 psi, or below. All Navy and Marine Corps aircraft are designed, built, and tested for refueling within these pressure limitations.

The Ford Class shall be limited to 45 psi.

5.1.3 Pressure Refueling Nozzles

Only those Single Point Refueling (SPR) nozzles that meet the requirements of SAE AS5877 are approved for use ([Appendix A](#)). Nozzles shall be equipped with 60-100 wire mesh screen (0.25-0.15mm sieve) to trap particulates from the issue system. A quick disconnect sampling connection shall be provided on the nozzle for taking fuel samples and for pressure checks. Sample connections shall be flush type, dry break quick disconnects (for example, Gammon fittings). Gammon fitting dust plugs shall not be used aboard ships since they present a Foreign Object Damage (FOD) hazard to the aircraft.

5.1.4 Nozzle Flushing Connection

The SPR flushing connection shall conform to MIL-A-25896 with dust cover.

5.1.5 Hose End Pressure Regulator (HEPR)

The HEPR supplements the primary pressure control valve used on shipboard refueling systems. The HEPR ensures the fuel pressure at the skin of the aircraft does not exceed 55 psig (45 psig for CVN-78 class ships).





5.1.6 Unisex Couplings

These couplings are used to join the components of the NATO High Capacity HIFR equipment together. Unisex couplings have identical mating surfaces on both halves and are completely interchangeable; there are no male or female halves. Unisex couplings come in two variations: valved and non-valved. Valved couplings are generally used on hose ends and connections to a ship's aviation fuel piping. Non-valved ends are used primarily on refueling nozzles.



In order to prevent the build-up of pressure in refueling nozzles caused by thermal expansion of trapped fuel, valved unisex couplings shall not be used on refueling nozzles.

5.2 SHIPBOARD AIRCRAFT REFUELING SYSTEMS

5.2.1 On-Deck Refueling Systems

Two types of aircraft fuel systems are in use aboard ship. Aviation ships (CVN, LHA, LHD, LPD) have aviation fuel systems incorporating a pressure and flow control valve (e.g., CLA-VAL) that controls service system delivery pressure. Air-capable ships have aviation fuel systems incorporating an unloader valve that controls service system delivery pressure. Aviation ships shall use D-1 refueling nozzles. Air-capable ships shall use D-1R nozzles (D-1 with a hose end pressure regulator). [Figures 5-1](#) and [5-2](#) illustrate the major features of these two systems. Refer to NSTM 542 for a detailed discussion of these systems.

5.2.2 Helicopter In-Flight Refueling Equipment

All HIFR-capable ships are equipped with the rig discussed below.

5.2.2.1 NATO High Capacity (NHC) HIFR

(See [Figure 5-3](#).) This rig features a 100-foot, 2-inch lightweight hose, unisex couplings, and automatic emergency breakaway and facilitates the use of either a CCR nozzle or a D-1 nozzle (SPR) for HIFR operations. The NHC has two major assemblies:

1. Deck assembly kit — 100 feet of non-collapsible deck hose configured with unisex couplings and an overwing nozzle with unisex coupling. The standard D-1R nozzle is reconfigured to end in a unisex coupling.
2. HIFR kit — 100 feet of lightweight collapsible hose with the deck tiedown, 10-feet of non-collapsible hose configured with an automatic breakaway on one end and a 45-psig CCR nozzle on the other. The CCR nozzle has a built-in 45 psi pressure regulator and an on/off flow control handle that allows the crewman to control fuel flow on and off. The emergency breakaway is initiated when 450 ± 50 pounds of straight tensile pull is exerted on the automatic breakaway coupling. The mount for the hoist cable has been designed for self-alignment between the winch and deck tiedown to assure straight pull.

Note

- Emergency breakaway occurs automatically as the helicopter moves away from the ship. No action by aircrew is necessary.
- All U.S. Navy and Marine Corps HIFR capable helicopters are outfitted with a CCR connection for HIFR while the helicopters of other NATO countries use an SPR connection.
- A special recirculation adapter (nozzle) is provided with the NHC rig. It allows the CCR nozzle to be attached to the ship's flushing connection (SPR adapter). This "recirculation nozzle" is outfitted with a fuel sampling port since the CCR nozzle cannot be configured with one ([Figure 5-4](#)).





5.2.3 Fuel Testing Laboratory

All ships that refuel aircraft are required to have a fuels laboratory where the fuel quality surveillance tests can be performed safely (see [paragraph 3.4.1](#)). Ships that refuel multiple aircraft shall have a laboratory that meets the following minimum requirements:

1. Lighting and fixtures in accordance with applicable ships' specifications.
2. Climate control, for example, air-conditioning/heating.
3. Sink with running hot and cold water.
4. Work bench(s) or counter(s) of sufficient size to accommodate all required test equipment such that each device is maintained in a ready-to-use position.
5. Storage cabinets for test equipment support items, for example, bottles, drying rack, spare millipore pads.
6. Hydrometers.
7. CFD or the CCFD.
8. FWD or CCFD.
9. B/2 Anti-Icing Test Kit.
10. Pensky-Marten or Naviflash flash point tester.
11. Thermometers.
12. Fume hood.
13. Eye wash station located within the vicinity (~10 feet) of the fuels testing laboratory.

Note

It is recommended that each activity possess at least two CCFDs or two CFDs and two FWDs in operating condition. The second unit is a back-up in case the primary unit fails. For those ships equipped with the Autogrape, the CCFD and the FWD shall serve as a back-up to the automated sampling device in case manual sampling is required. Aircraft refueling operations shall not be performed if fuel contamination levels cannot be routinely tested as required by [Chapter 3](#) of this manual.

Ships that do not have a laboratory and/or fume hood shall designate a specific area in the ship with good ventilation where the testing equipment listed in [paragraph 3.4.2](#) can be stored and conveniently set up and operated on a moment's notice.





Figure 5-1. Shipboard Aircraft Fueling System Flow Diagram — Carrier and Amphibious Assault Aviation Ships

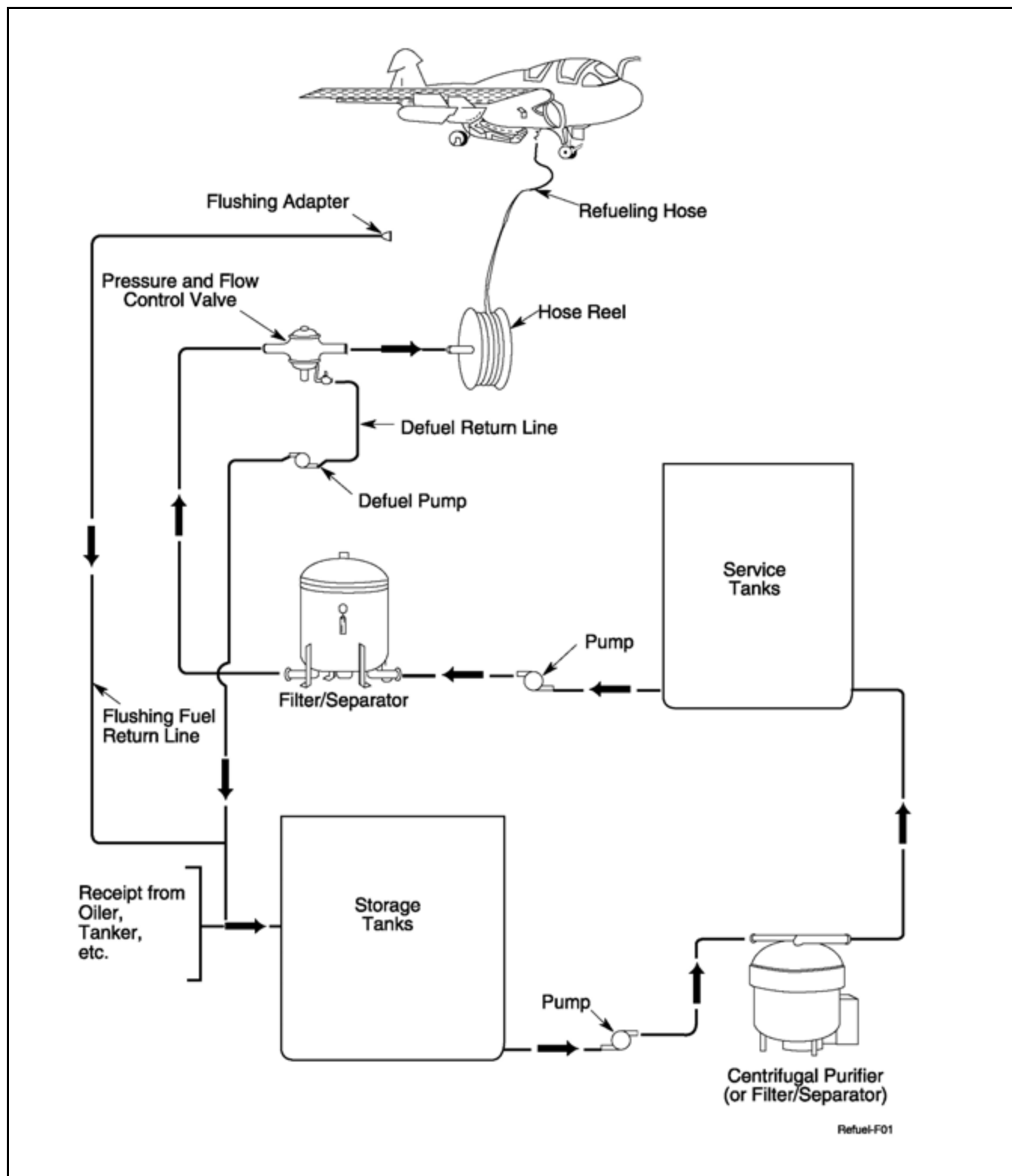




Figure 5-2. Shipboard Aircraft Refueling System Flow Diagram — Air-Capable Ships

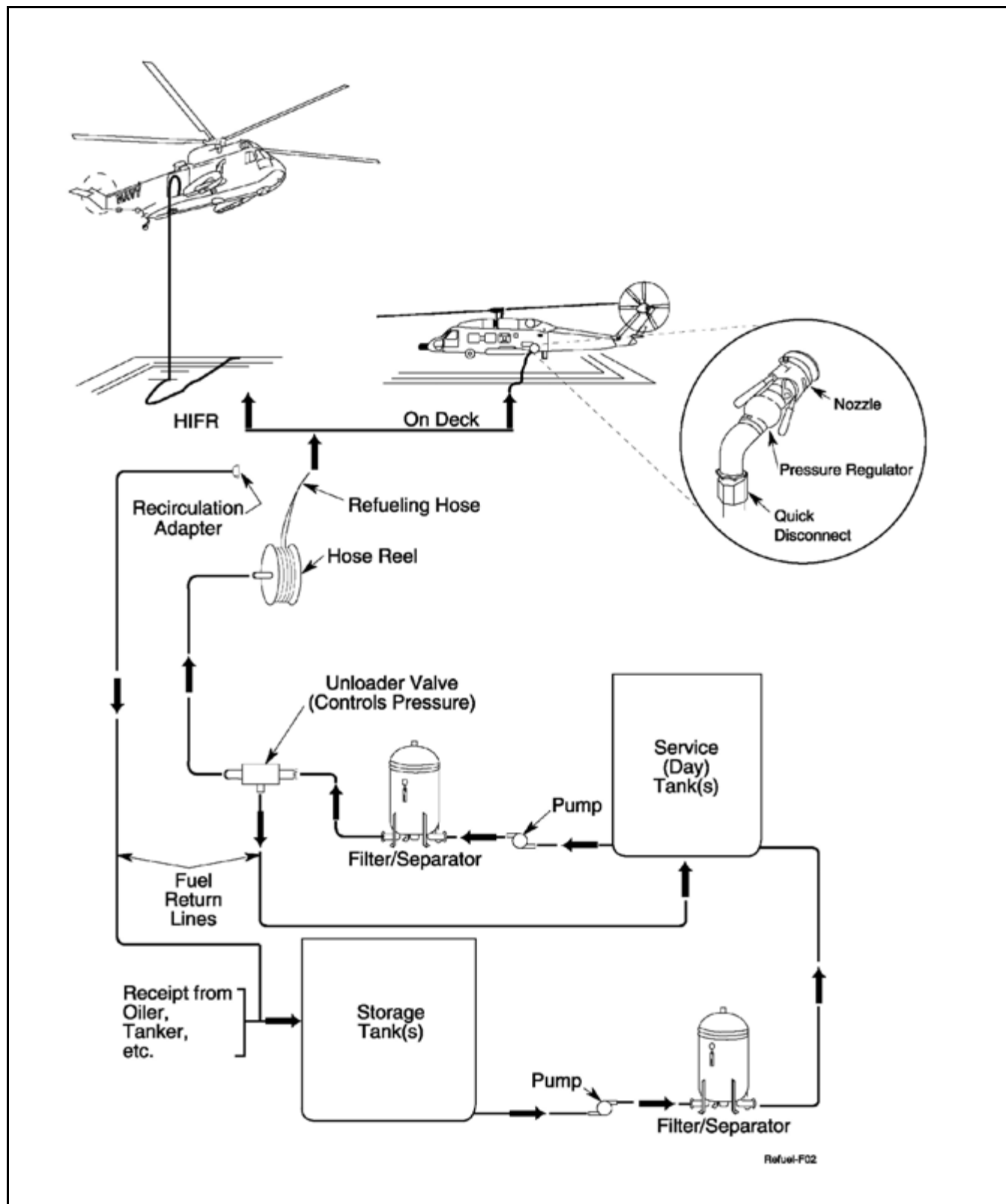




Figure 5-3. NATO High-Capacity (NHC) HIFR Assembly

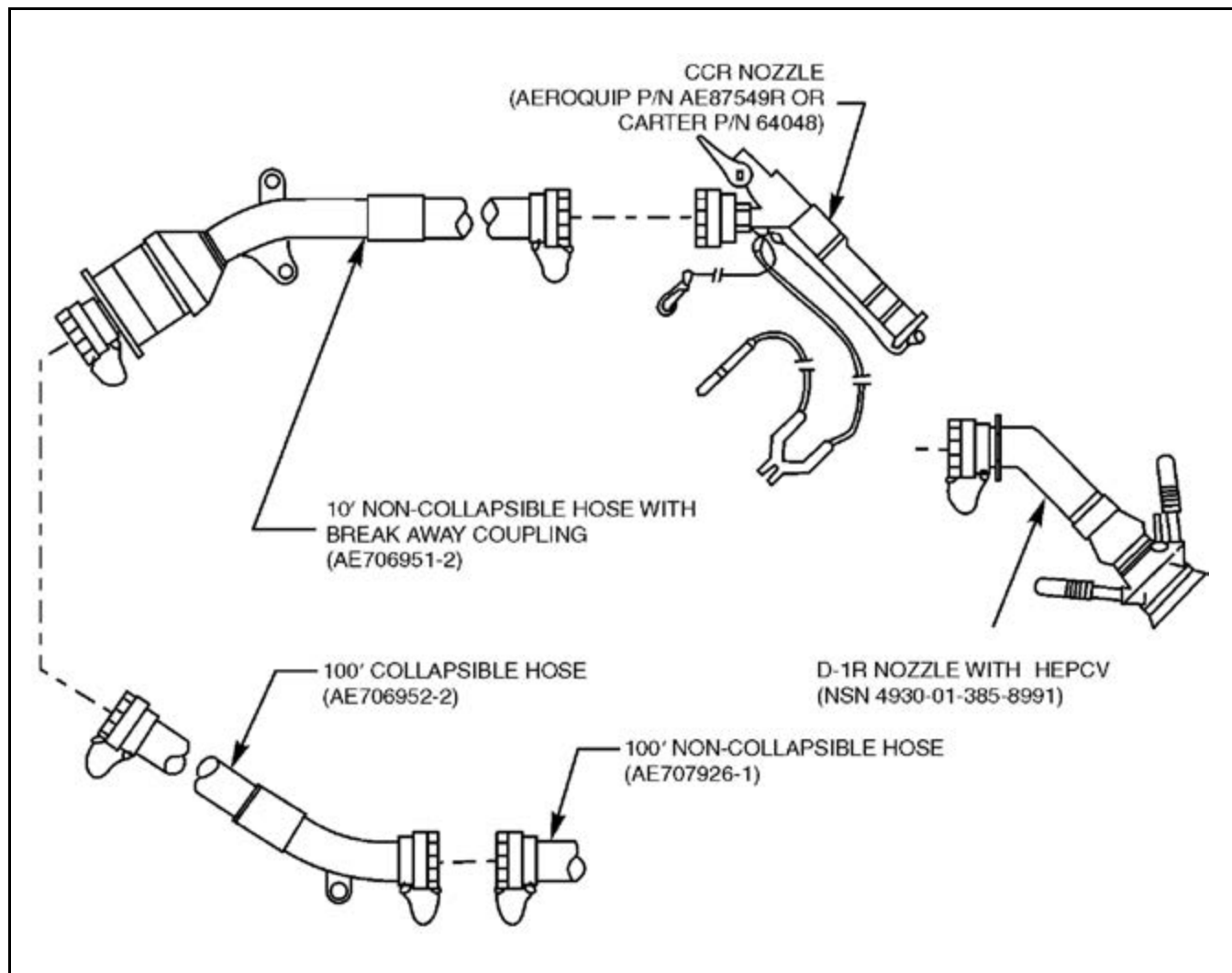
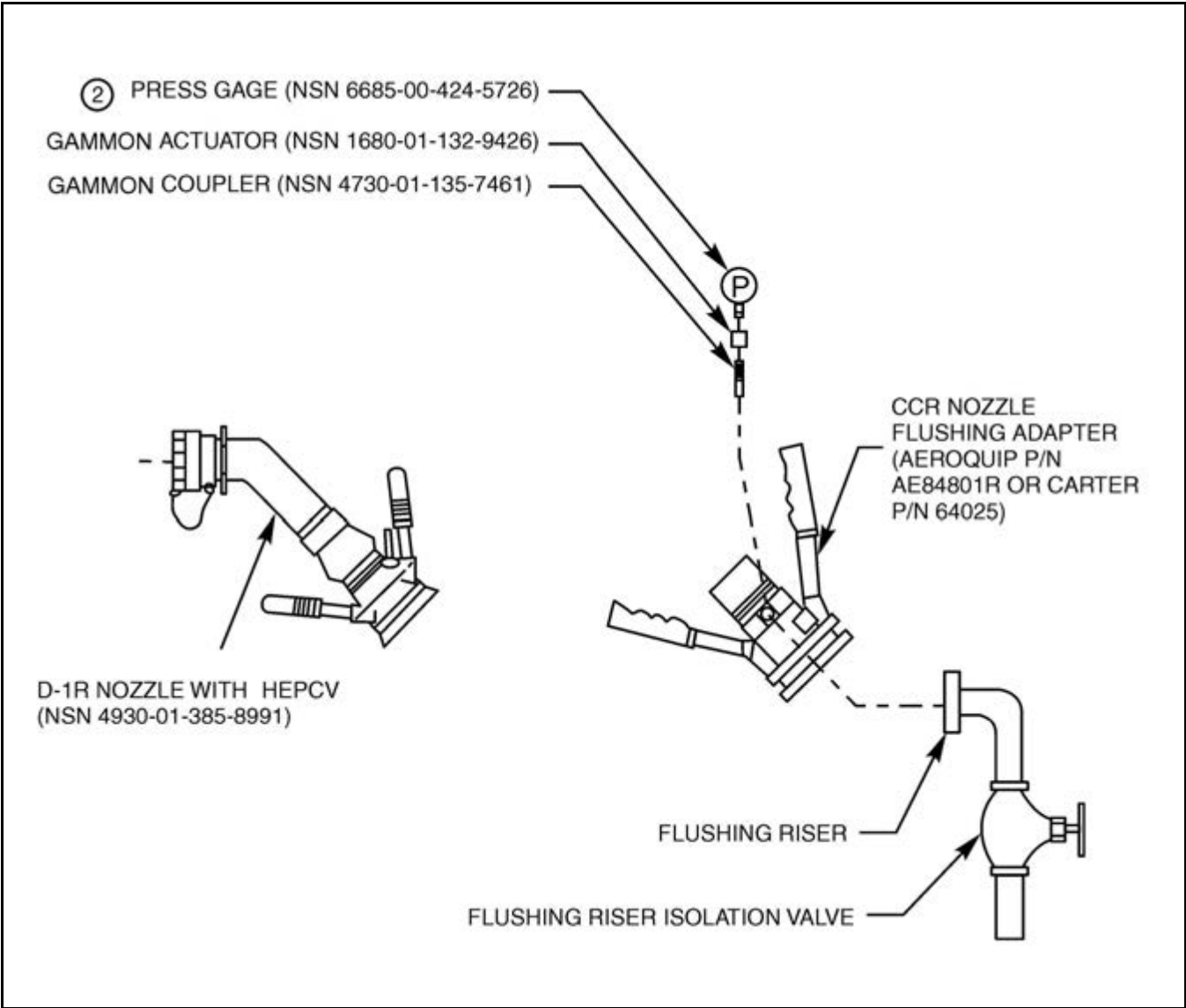




Figure 5-4. NHC Flushing Adapter and Pressure Refueling Nozzles





CHAPTER 6

Shipboard Operating Procedures

6.1 INTRODUCTION

This chapter establishes minimum operating procedures to assure safe handling of aviation fuel. The operating procedures presented and discussed in this chapter are for general types of fuel facilities and equipment common to all ships engaged in the fueling of aircraft. They include the basic steps that, for safety reasons, must be performed with each fuel handling operation with particular emphasis on the fueling of aircraft. Any departure from the procedures of this chapter may adversely affect the overall safety of the operation being performed.

Fuel operators shall discontinue any fuel operation that does not appear to be progressing in a normal fashion (i.e., appears to be taking much longer than would normally be expected, or pressures are too high, too low, etc.) or when a safety violation is in evidence, and immediately notify the Fuels Officer or FMO.

WARNING

Failure to terminate an operation that is progressing abnormally can lead to a catastrophic accident.

6.2 SHIPBOARD AIRCRAFT REFUELING PROCEDURES

The following shipboard operating procedures cover only those activities directly involved with the refueling of aircraft. They do not cover the below-deck operations that must be performed in conjunction with the aircraft refueling operation. The procedures presented here have been developed to assure compatibility between shipboard procedures and those published in the individual NATOPS Manual for each aircraft.

General shipboard operating procedures, including below-deck activities as well as aircraft refueling, are contained in the Naval Ships' Technical Manual, Chapter 542, NAVSEA S9086-SP-STM-000/CH-542. Ships that have been outfitted with an Operational Sequencing System (OSS) have OSS Manuals that contain very detailed operating instructions for their shipboard systems.

6.2.1 Operation of the JP-5 System

All operations involving the JP-5 system shall be conducted by qualified operators per the AVFUELS (Afloat) PQS. Trainees may operate the system, but only under the direct supervision of a qualified operator. All operations of the Aviation Fuel (AVFUEL) system shall be done in strict accordance with Operational Sequencing System (OSS), local procedures or an approved Temporary Operating Instruction (TOI) as necessitated to safely operate in a non-standard configuration.

Note

- A fueling/defueling crew consists of a qualified crew leader who will act as a station operator with established communications, a minimum of one qualified crewman per hose in use, and a plane captain/aircrew. A PQS qualified fuels flight deck supervisor shall be available "on deck" to coordinate fueling operations and to act as Safety Petty Officer.
- Every effort shall be made to use existing technology and/or ship's information systems to accomplish tasks in the most safe and efficient use of manpower. Manual tasks, such as tank soundings, shall only be undertaken when the ship's information system is down, or the results are in question.





6.2.2 Log Books

JP-5 quality surveillance fuel sample log, filter sample/pressure drop log, and equipment running logs shall be maintained in the formats found in [Figures A-6, A-7, and A-8](#). For systems with an automated sampling device installed, real-time fuel quality output data at a specific location is displayed on the specific ship's machinery control system and recorded on the applicable data acquisition system or manually entered by the applicable operator. Each log and automated sampling device data record (if applicable) shall be reviewed by the supervisor, CPO and Maintenance Officer daily and kept in division files for 1 year.

Daily aircraft fuel/defuel log, refueling card, and V-4 daily fuels report shall be maintained in the formats found in [Figures A-9, A-10, and A-11](#). Each log shall be reviewed by the watch standers supervisor, workcenter CPO, and the fuels maintenance officer and kept in division files for 24 months.

6.2.3 Aircraft Pressure Refueling with Engines Off (Cold Refueling)

WARNING

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

A fueling/defueling crew consists of a qualified crew leader who will act as a station operator with established communications, one qualified crewman per nozzle in use, and a plane captain/aircrew. A PQS qualified fuels flight deck supervisor shall be available "on deck" to coordinate fueling operations and to act as Safety Petty Officer.

Aircraft refueling tasks are to be performed in the following sequence:

1. Secure all electronic and electrical switches on the aircraft not required for fueling.
2. Verify manned firefighting equipment is in the area.
3. Take sample, if needed, for quality surveillance checks. Fuel sample shall be taken under flow conditions. Fuel shall be flushed through refueling hose and nozzle and tested for contamination prior to refueling the first aircraft each day not to exceed 24 hours. Fueling shall not begin until acceptable results have been obtained (i.e., less than 2 mg/L sediment/particulates and 10 ppm free water). (See [Chapter 3](#).)

WARNING

Failure to provide clean, clear, and bright fuel to aircraft can adversely affect safety-of-flight.

Note

- For systems with an automated sampling device installed, quality surveillance checks are not required. Real-time fuel quality output at the specific location is displayed and recorded on the ship's machinery control system. Manual sampling may be used as a back-up to the automated sampling device, where the situation dictates. Manual visual and/or laboratory samples are required where the automated sampling device is not installed. The software receiving the data from the automated sampling device shall track time usage in order to continuously monitor the 24 hour requirement, indicating when hose flushing is required upon the elapse of 24 hours without fuel movement.
- Aircraft must have initial tiedowns prior to attachment of the grounding cable. Refer to individual aircraft NATOPS. Refueling shall not be performed unless a qualified plane captain/aircrew is present.





4. Align station for fueling in accordance with AFOSS/EOSS.
5. Attach grounding cable from the deck to the aircraft.

Once a fueling evolution has commenced, the aircraft's electrical power status and connections shall not be changed until evolution has been completed or refueling has been stopped for an emergency (e.g., no aircraft engines or APU shall be started or stopped and external power shall not be connected, disconnected, or switched on/off).

WARNING

- Changing the aircraft's electrical power status can create significant ignition sources.
- Aircraft tiedowns are not to be removed or altered during aircraft refueling evolutions or a catastrophic accident may occur.
- Securing or attaching grounding connectors/cables to external doors, latches or hinges may cause a catastrophic accident.

Note

Switching off the F-35 28V battery does not provide a hazardous ignition source and is an acceptable procedure during refueling.

6. Position the fuel hose.
7. Remove refueling adapter cap from the aircraft and the dust cover from the SPR nozzle. Inspect the face of the nozzle and make sure it is clean. Inspect index pin area for excessive wear. Verify the flow control handle is in the fully closed and locked position.
8. (Plane captain/aircrew) Visually inspect the aircraft's adapter (receptacle) for any damage or significant wear. If there is any doubt about the integrity of the adapter, notify the squadron representative who shall utilize the adapter go/no-go gauge (NSN 5220-01-301-9247) or alternate go/no-go gauge (NSN 5220-01-343-1688, 5220-01-554-2538) to determine acceptability.

WARNING

A worn or broken adapter can defeat the safety interlocks of the refueling nozzle permitting the poppet valve to be in the open position when removed from the SPR adapter and fuel to spray or spill.

9. Confirm that the switch on the nozzle Quick Disconnect Coupling (QDC) is in the OFF position (if applicable).
10. Lift nozzle by lifting handles, align the lugs on the nozzle with the slots on the aircraft adapter, and hook up the nozzle to the aircraft by pressing it firmly onto the adapter and rotating it clockwise to a positive stop.

WARNING

Nozzle must seat firmly on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system that can lead to a fuel spray or spill.



**Note**

- Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. A defective or worn aircraft SPR can also be detected in this manner.
 - The recessed fuel panel of the Army AH-64A/D helicopter may cause interference with the original version of the Carter #64349 SPR nozzle. This nozzle must be mounted with the flow control handle oriented at the 8 o'clock position, to allow full travel of the handle.
11. Upon receiving signals from the nozzle operator that hook-up is complete and from the plane captain that he/she is ready to begin fueling operation, the station operator opens the appropriate valve (for air-capable ship only). The station operator should remain in position at controls throughout the entire fueling operation.
 12. Place QDC switch in the ON (fuel) position (if applicable).
 13. When hose is fully charged, rotate the nozzle flow control handle to the FULL OPEN position. The handle shall rotate 180 degrees to ensure the poppet valve is fully open and locked.

WARNING

The flow control handle of the SPR nozzle shall be placed in either of two locked positions — fully open or fully closed. The handle is not to be used as a flag to indicate fuel flow. Excessive wear on the aircraft adapter and the fuel nozzle poppet will result if the handle is allowed to “float” in the unlocked position.

14. Once fuel flow has been established, plane captain/aircrew shall exercise the aircraft's precheck system.

Note

- The precheck system simulates the completion of refueling by closing all of the tank shut-off valves within the aircraft. All fuel flow into the aircraft should stop within a few seconds to 1 minute of actuating the precheck system. On ship the only means of detecting successful precheck is by observing the flow indicator on the aircraft. If the aircraft is not configured with a flow indicator there will be no positive indication that precheck has successfully occurred (hose stiffening/jerking and pressure spikes can occur whenever one or more aircraft fuel tank refueling valves close).
 - If an aircraft fails precheck it can be cold refueled only if procedures are called out in the specific aircraft NATOPS.
 - Refueling crewmembers will not perform prechecks on aircraft. Qualified personnel will perform the prechecks in accordance with specific aircraft NATOPS.
15. Fuel aircraft as directed by flight plan. The plane captain/aircrew shall monitor aircraft vents, tank pressure gauge(s) and/or warning lights as necessary.
 16. When directed by the plane captain/aircrew, stop fuel flow by placing the nozzle flow control handle to the fully closed position. Place the quick disconnect switch in the off position (if applicable).
 17. When hose is evacuated, disconnect nozzle from the aircraft adapter, replace nozzle dust cover, replace adapter cap, and remove ground wire from aircraft, then deck.
 18. If applicable, shut down refueling station.





19. Restow hose.

6.2.4 Overwing Refueling

WARNING

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

Note

See [Appendix E](#) for overwing hot refueling in support of special operations forces (SOF) missions.

Overwing (gravity) refueling can be performed only with the engines off. The following tasks shall be performed in the following sequence:

WARNING

Overwing refueling with the aircraft's engines operating is not authorized.

1. Secure all electronic and electrical switches on the aircraft not required for fueling (plane captain).
2. Verify manned firefighting equipment is in the area.
3. Take sample if needed for quality surveillance checks. Fuel sample shall be taken under flow conditions. Fuel shall be flushed through refueling hose and nozzle and tested for contamination prior to refueling the first aircraft each day not to exceed 24 hours. Fueling shall not begin until acceptable results have been obtained, that is, less than 2 mg/L sediment/particulates and 10 ppm free water. (See [Chapter 3](#).)

WARNING

Failure to provide clean, clear, and bright fuel to aircraft can adversely affect safety-of-flight.

Note

- Recirculate the refueling station and take samples with the SPR nozzle in place, then replace the SPR with overwing nozzle immediately before commencing refueling operations.
- For systems with an automated sampling device installed, quality surveillance checks are not required. Real-time fuel quality output at the specific location is displayed and recorded on the ship's machinery control system. Manual sampling may be used as a back-up to the automated sampling device, where the situation dictates. Manual visual and/or laboratory samples are required where the automated sampling device is not installed. The software receiving the data from the automated sampling device shall track time usage in order to continuously monitor the 24 hour requirement, indicating when hose flushing is required upon the elapse of 24 hours without fuel movement.
- Aircraft must have initial tiedowns prior to attachment of the grounding cable. Refer to individual aircraft NATOPS.





4. Align Station for fueling in accordance with AFOSS/EOSS.
5. Attach grounding cable from the deck to the aircraft.

Once a fueling evolution has commenced, the aircraft's electrical power status and connections shall not be changed until evolution has been completed or refueling has been stopped for an emergency (e.g., no aircraft engines or APU shall be started or stopped and external power shall not be connected, disconnected, or switched on/off).

WARNING

Changing the aircraft's electrical power status can create significant ignition sources.

Note

- Refueling shall not be performed unless a qualified plane captain/aircrew is present.
 - Switching off the F-35 28V battery does not provide a hazardous ignition source and is an acceptable procedure during refueling.
6. Reel out and position the fuel hose.
 7. Confirm that the switch on the nozzle QDC is in the OFF position (if applicable).
 8. Bond the overwing nozzle to the aircraft as shown in [Figure 6-1](#) and then remove the filler cap from the aircraft.

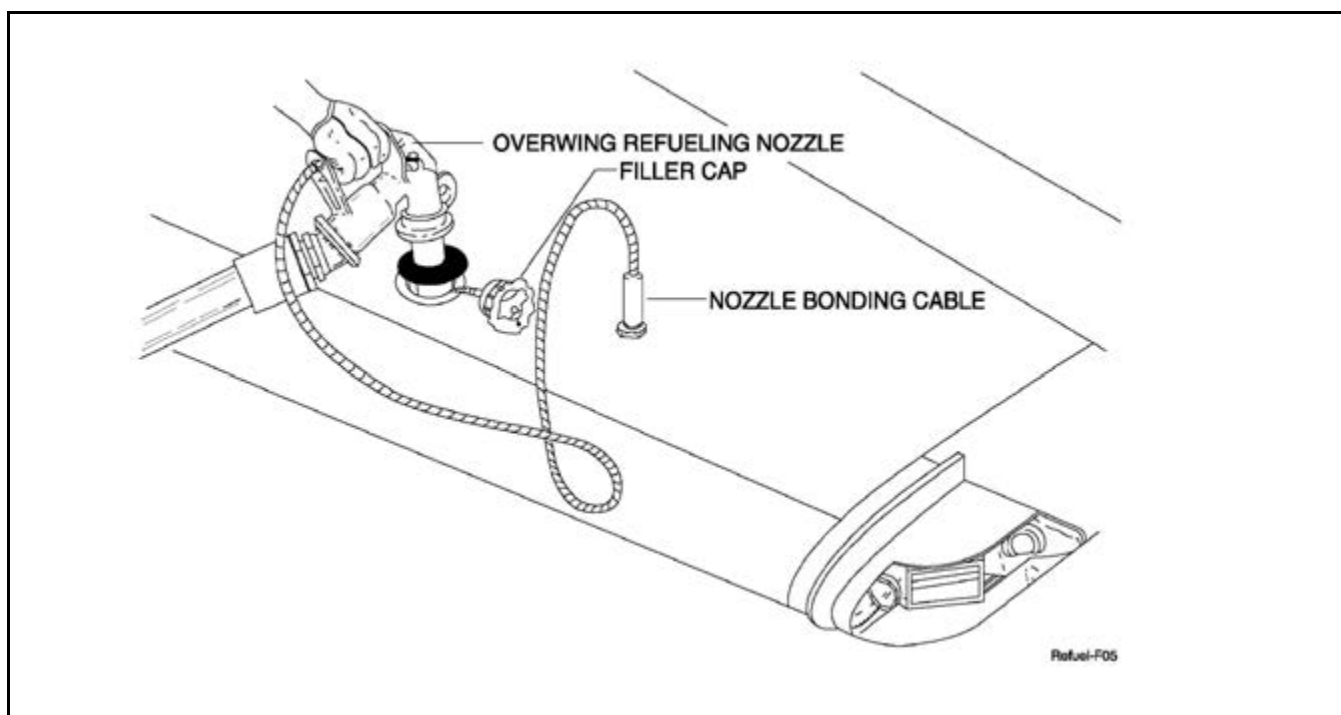
WARNING

Always bond the nozzle to the aircraft before the filler cap is removed. This connection shall remain in place until the entire fueling operation is complete. Failure to bond nozzle and/or maintain contact can result in a dangerous static spark inside the fuel tank.





Figure 6-1. Electrical Bonding of Overwing Refueling Nozzle to Aircraft



9. Remove nozzle dust cover and insert overwing nozzle into aircraft's refueling port and maintain metal to metal contact between the overwing nozzle and the aircraft's refueling port throughout the entire fueling operation.
10. Upon receiving signals from the nozzle operator that the plane captain/aircrew is ready to begin fueling operation, the station operator opens the appropriate valve (for air-capable ship only). The station operator must remain in position at controls throughout the entire fueling operation.
11. Place QDC switch in the ON (fuel) position (if applicable).
12. Fuel aircraft as directed by flight plan. The plane captain/aircrew shall monitor aircraft vents, tank pressure gauge(s), and/or warning lights as necessary.

WARNING

Self-closing nozzles shall not be blocked open or bypassed. This defeats the purpose of the device and can lead to a catastrophic accident.

13. When directed by the plane captain/aircrew, stop fuel flow.
14. Place the QDC switch in the OFF position (if applicable).
15. Remove the nozzle from aircraft refueling port, replace dust cover, and replace filler cap.
16. Remove nozzle bonding cable from aircraft then remove ground wire from aircraft.
17. Shut down refueling station.
18. Restow hose.





6.2.5 Aircraft Pressure Refueling with Engines Operating (Hot Refueling)

Hot refueling procedures are the same as the cold refueling procedures listed in [paragraph 6.2.3](#) with the following additions.

The following steps must be accomplished prior to the initiation of the refueling operation:

1. Aircraft pilot shall select fuel loading, ensure the cockpit switches are in the proper positions, and maintain UHF radio contact with the Primary Flight Control (PriFly).
2. Pilot shall secure all unnecessary electronic and electrical equipment not required for refueling.
3. Pilot shall place all armament switches in the SAFE position.

The following prohibitions shall be observed:

- a. Servicing the AV-8B's water injection system/tank is not authorized during hot refueling.
 - b. Aircraft shall not be hot refueled if it fails precheck. Failure of the precheck indicates a malfunction in the aircraft's fuel system, which can result in a fuel spill and fire.
 - c. For helicopters with dual controls, concurrent hot refueling and hot seating evolutions may be conducted if at least one pilot is guarding the controls and the hot seat evolution takes place on the opposite side of the aircraft to the refueling adapter. For all other aircraft, crew changes and hot seating shall not be conducted during hot refueling.
 - d. For fixed wing aircraft, the engine with the propeller or intake nearest the aircraft fueling receptacle shall be secured. Deviations are permitted only when specific aircraft NATOPS states to leave both engines running.
 - e. Hot refueling on CVN spot 8 is not authorized.
 - f. Bow catapults slots seals shall be installed prior to fixed wing refueling/defueling evolutions.
 - g. Waist catapults slots seals shall be in place immediately after flight operations. Slot seals are not required to be in place on the waist when flight quarters is set. Shuttles positioned forward or aft on the waist will be acceptable while refueling/defueling during flight quarters. However, every safety precaution shall be observed due to complexity of refueling/defueling operations in the vicinity of the waist catapults.
 - h. Aircraft canopy and helicopter side doors (if installed) shall remain closed during the entire refueling evolution. Aircraft refueling operations shall be secured if canopy is opened.
 - i. Exceptions:
 - (1) Rear cargo doors and/or doors on opposite side of aircraft from the refueling adapter may be open, provided the refueling hose is positioned so that it is unlikely fuel sprays from nozzle/adapter malfunction or hose rupture will enter aircraft passenger/cargo/cockpit compartment(s).
 - (2) The AV-8B aircraft may be hot refueled with the canopy open at the pilot's discretion when high temperatures and humidity dictate, since the aircraft's environmental control system does not operate with weight on wheels.
 - (3) The MH-60S helicopter may be hot refueled with the 20mm Gun System installed without the environmental barrier provided the left cabin door is held against the feed chute and the refueling hose is positioned so that it is unlikely fuel sprays from nozzle/adapter malfunction or hose rupture will enter aircraft cabin and/or cockpit compartment(s).
4. Obtain samples from each aircraft fueling nozzle after flushing and prior to commencing aircraft operation in accordance with PMS/OSS directives.

Note

Samples drawn during static (no flow) conditions are not representative of the full fuel flow and may give false high contaminant results.





5. On CVN/LHA/LHD class ships, during helicopter hot refueling evolutions, fuel samples shall not be taken for testing prior to flight.
6. On air capable ships, fuel samples shall be obtained and tested for sediment/particulates and free water prior to initial daily refueling evolutions

For systems with an automated sampling device installed, quality surveillance checks taken under flow conditions are not required. Real-time fuel quality output at the specific location is displayed and recorded on the ship's data acquisition system or manually entered by the applicable operator. Manual sampling may be used as a back-up to the automated sampling device, where the situation dictates. Manual visual and/or laboratory samples are required where the automated sampling device is not installed. The software receiving the data from the automated sampling device shall track time usage in order to continuously monitor the 24 hour requirement, indicating when hose flushing is required once 24 hours has elapsed without fuel movement.

7. Hot refueling shall be performed using only the SPR or CCR nozzle and aircraft receptacle.
8. Aircraft shall not be gravity refueled with the engines and/or APU operating because of the increased probability of a fuel spill and fire.

Note

Gravity refueling with the engines and/or APU operating is authorized when providing refueling services to SOF units per [Appendix E](#).

6.2.6 Helicopter In-Flight Refueling (HIFR) Procedures

HIFR is performed to extend a helicopter's on-station time. Hot refueling (refueling on deck while rotors are turning) is preferable to night HIFR. A minimum of five ships' crewmen in addition to the LSE are needed on-deck to conduct an HIFR operation (i.e., one to tend the refueling station, two to tend the HIFR hose, one hook-up man, and a deck safety observer). The following procedures focus on the on-deck duties of the ship's refueling crew. Additional information on HIFR operations is contained in NAVAIR 00-80T-122, Aircraft Operating Procedures for Air Capable Ships, and the Naval Ship's Technical Manual Chapter 542.

1. All components of the HIFR rig shall be checked for electrical continuity in accordance with PMS.
2. The HIFR rig shall be connected to the ship's aviation refueling system and pressurized to check for leaks during flushing operations.
3. The HIFR nozzle shall be attached to the recirculation adapter and flushed with fuel.
4. During flushing, a fuel sample shall be taken from the sampling port on the HIFR Rig, unless an automated sampling device is installed to provide the real-time fuel quality results.

Note

The CCR nozzle provided with the NHC assembly is not provisioned with a sample port. A sample must be taken from the recirculation nozzle at the flushing adapter.

5. Recirculation shall be continued until a clear and bright sample that meets both the 2 mg/L sediment/particulates and 10 ppm water limits is obtained when tested using the CCFD and FWD, or results indicated by an installed automated sampling device. A 1-quart sample of fuel will be retained at the refueling station for delivery to the helicopter if requested.
6. The system shall be depressurized but full of fuel and the hose and rig laid out on the deck as shown in [Figures 6-2, 6-3, and 6-4](#). To facilitate hose handling in the helicopter when using the NHC HIFR assembly, the nozzle shall be attached to the pickup saddle using a snaplink arrangement (see [Figure 6-5](#)) or a locally manufactured sling arrangement (reference NAVSEA NHC HIFR assembly installation manual).
7. The entire area of the ship that is subject to helicopter rotorwash shall be inspected for the removal of all FOD.
8. All flight deck safety nets (if applicable) and other obstructions shall be lowered.





9. The helicopter shall approach the ship from the stern, hover over the HIFR “H” marking, and lower its hoist to the deck of the ship. Normally a fuel sample bag will be attached to the hoist when it is lowered.
10. Touch the grounding wand to the helicopter's hoist and keep it in touch while placing the fuel sample in the bag.

WARNING

- Do not attempt to touch the hoist with the grounding wand until it has been completely lowered and is sitting on the deck. Dangerous static charges can be released when the hoist first strikes the deck or grounding wand.
 - Personnel handling grounding wand must wear appropriate insulated gloves. During HIFR of an H-53E, the individual manning the grounding wand shall wear insulated Class III, Type I (26,500 volts) rubber gloves. This individual shall not tend the fueling hose.
 - Under no circumstances shall the helicopter hoist cable be secured to any part of the ship.
11. Fuel sample will be hoisted into the helicopter for inspection.
 12. Helicopter crew will again lower the hoist and sample.
 13. Allow the hoist to again land on the deck before attempting to touch the grounding wand to it.
 14. Attach the hoist to the HIFR saddle.
 15. Aircrew will raise the hoist, connect the nozzle grounding wire to the aircraft, and connect the nozzle to the aircraft's HIFR connection. The helicopter will then move clear of the deck to port, and descend slightly.
 16. Aircrewman will signal refueling crew on deck to commence fueling using appropriate signals given in NAVAIR 00-80T-113/NAVAIR 00-80T-122.

WARNING

Do not pressurize the HIFR hose prior to receiving the “commence pumping” signal from the aircrewman. A pressurized hose will prevent hookup between the nozzle and the pressure fueling port and can result in a fuel spill inside the aircraft cabin.

17. At least two ships' crewmen shall tend the fueling hose to prevent excess slack from developing in the hose. It is essential that no excess strain be placed on the hose since this may actuate the emergency breakaway device in the NHC HIFR assembly.

WARNING

All personnel shall remain clear of the area between the fuel hose and the port deck edge after the helicopter has received the fuel hose. If the hose is drawn taut, personnel in this area could be pulled overboard.

18. When fueling is complete, the crewman shall signal for the pumping to stop. The helicopter will then be repositioned over the deck and the HIFR rig will be disconnected and lowered.
19. Restow the refueling hose and HIFR rig.





6.2.7 Refueling Aircraft with Auxiliary Power Unit (APU) Running

The aircraft APU may be used to supply electrical power for pressure refueling on military aircraft so equipped. Refueling with the APU running shall not be conducted in the hangar area. This operation is not considered “hot refueling”; however, the following precautions shall be observed in addition to the normal refueling procedures:

1. One plane captain/aircrew shall be located at the APU controls in the cockpit.
2. Hand signals/signal wands shall be established between cockpit and personnel performing refueling to ensure immediate shutdown in the event of emergency.

Note

Personnel in the vicinity of the aircraft shall wear full flight deck gear.

6.2.8 Concurrent On-Loading/Off-Loading and Refueling of Aircraft

Commanding Officers (COs) may grant authorization for concurrent refueling, cargo loading, and cargo off-loading in logistical airlift operations when minimum ground time is required to support military operations. Such authorization shall not include the loading and unloading of Class A and B explosives, but can include refueling with explosive cargo previously loaded and secured onboard.

Where concurrent refueling/loading/off-loading operations are authorized, COs shall establish stringent local regulations and procedures to ensure safety. In addition, the CO shall clearly designate one qualified person in charge of each operation.

The following procedures and precautions shall be included in the local regulations and procedures:

1. No passengers or patients shall remain onboard during concurrent refueling operations unless authorized by the CO.
2. LOX converter bottle can be exchanged but final connection shall not be made.
3. The procedures contained elsewhere in this chapter shall be followed as appropriate.





Figure 6-2. Sample CG NHC Layout

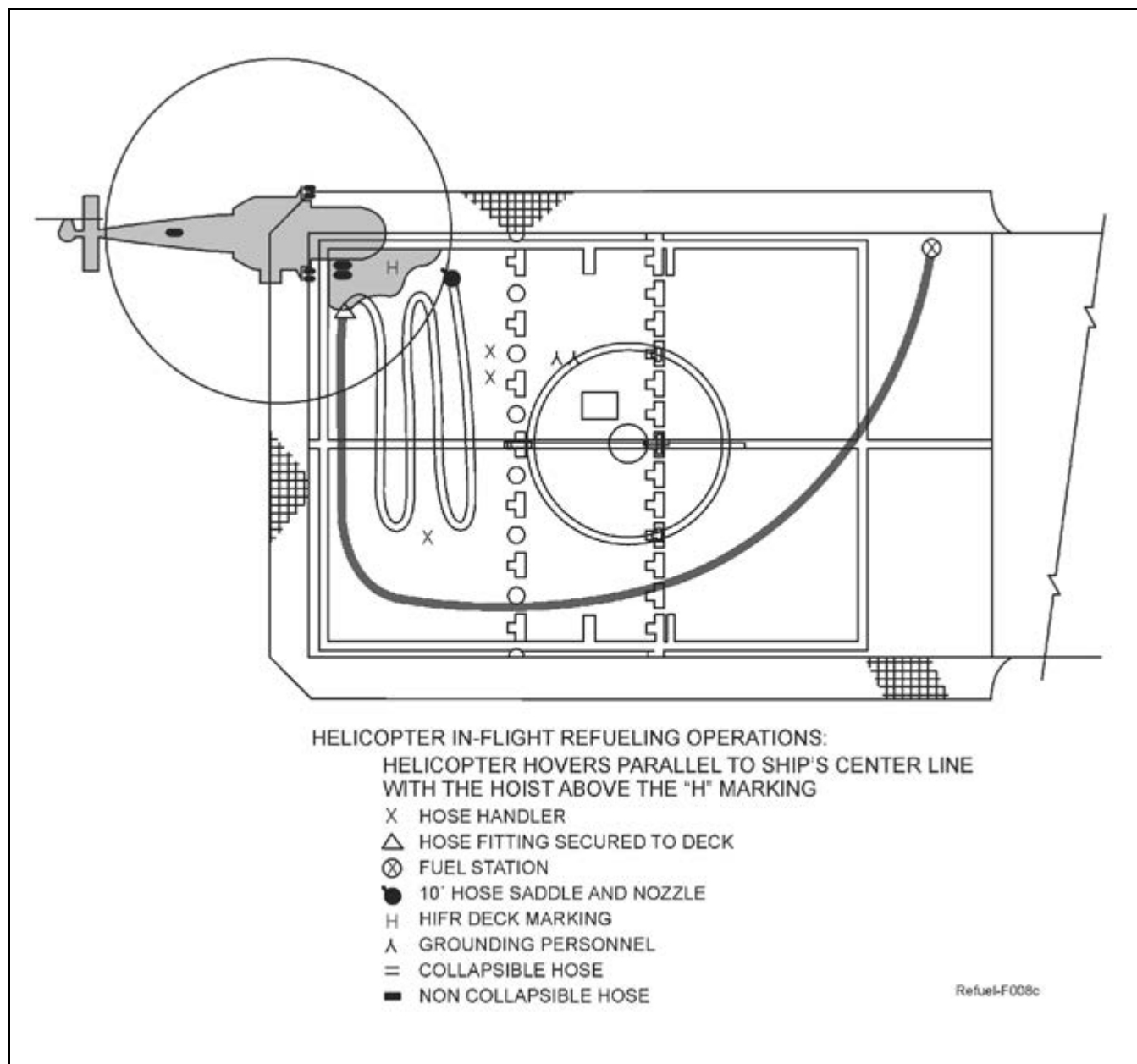




Figure 6-3. Sample DDG NHC Layout

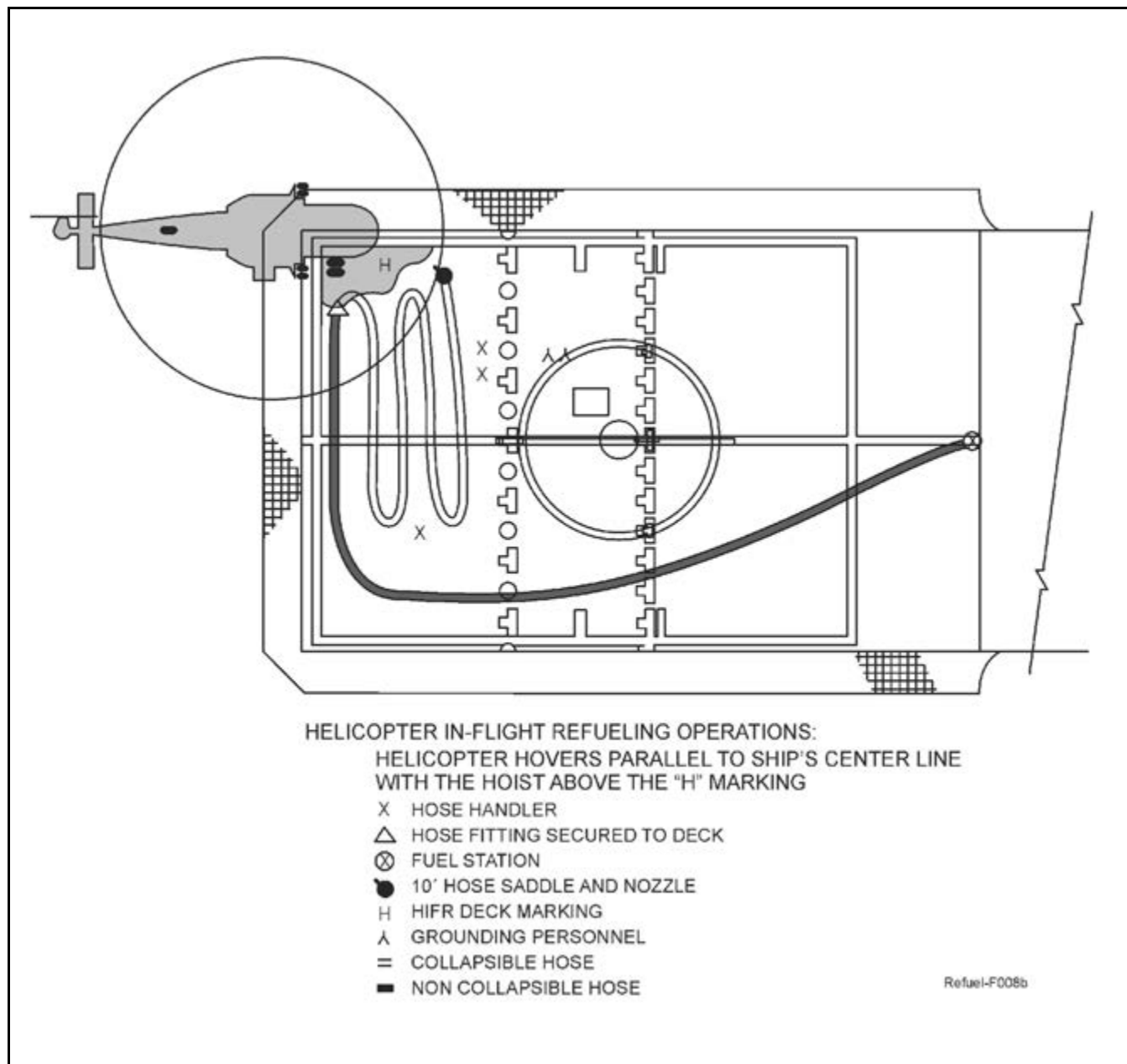
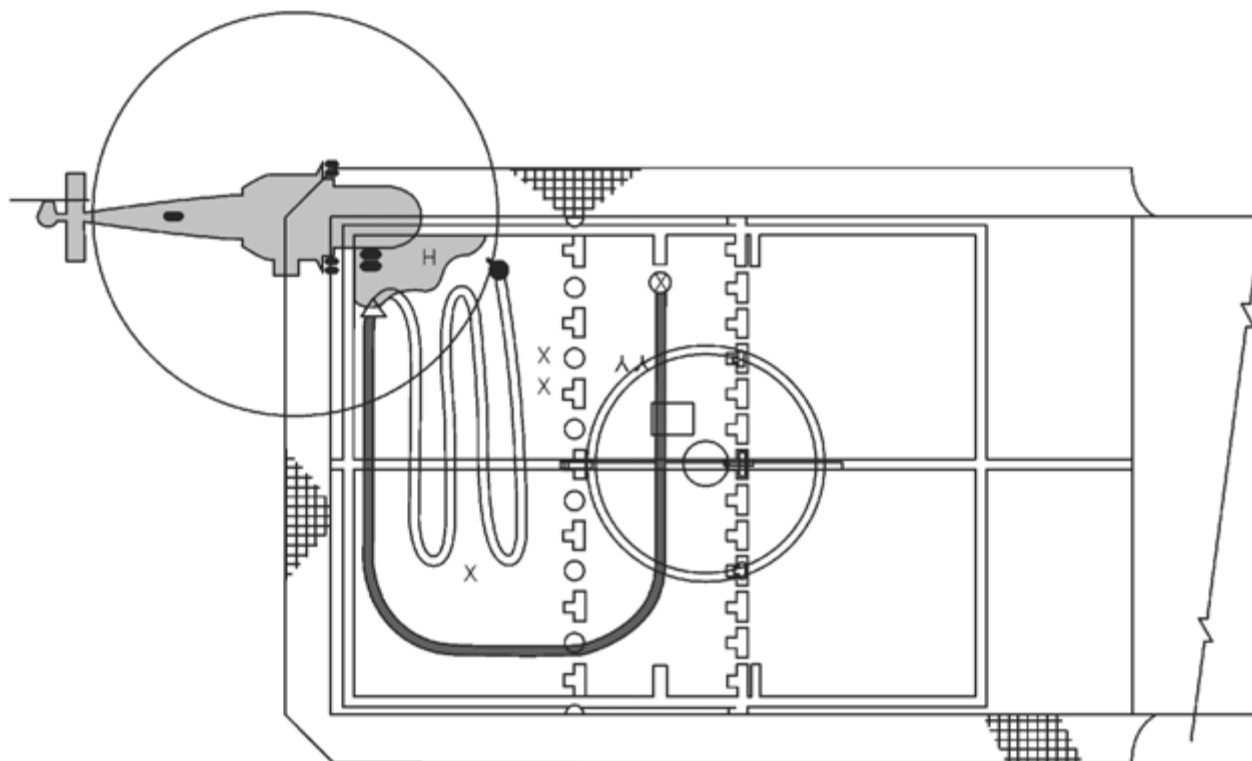




Figure 6-4. Sample FFG NHC Layout



HELICOPTER IN-FLIGHT REFUELING OPERATIONS:

HELICOPTER HOVERS PARALLEL TO SHIP'S CENTER LINE
WITH THE HOIST ABOVE THE "H" MARKING

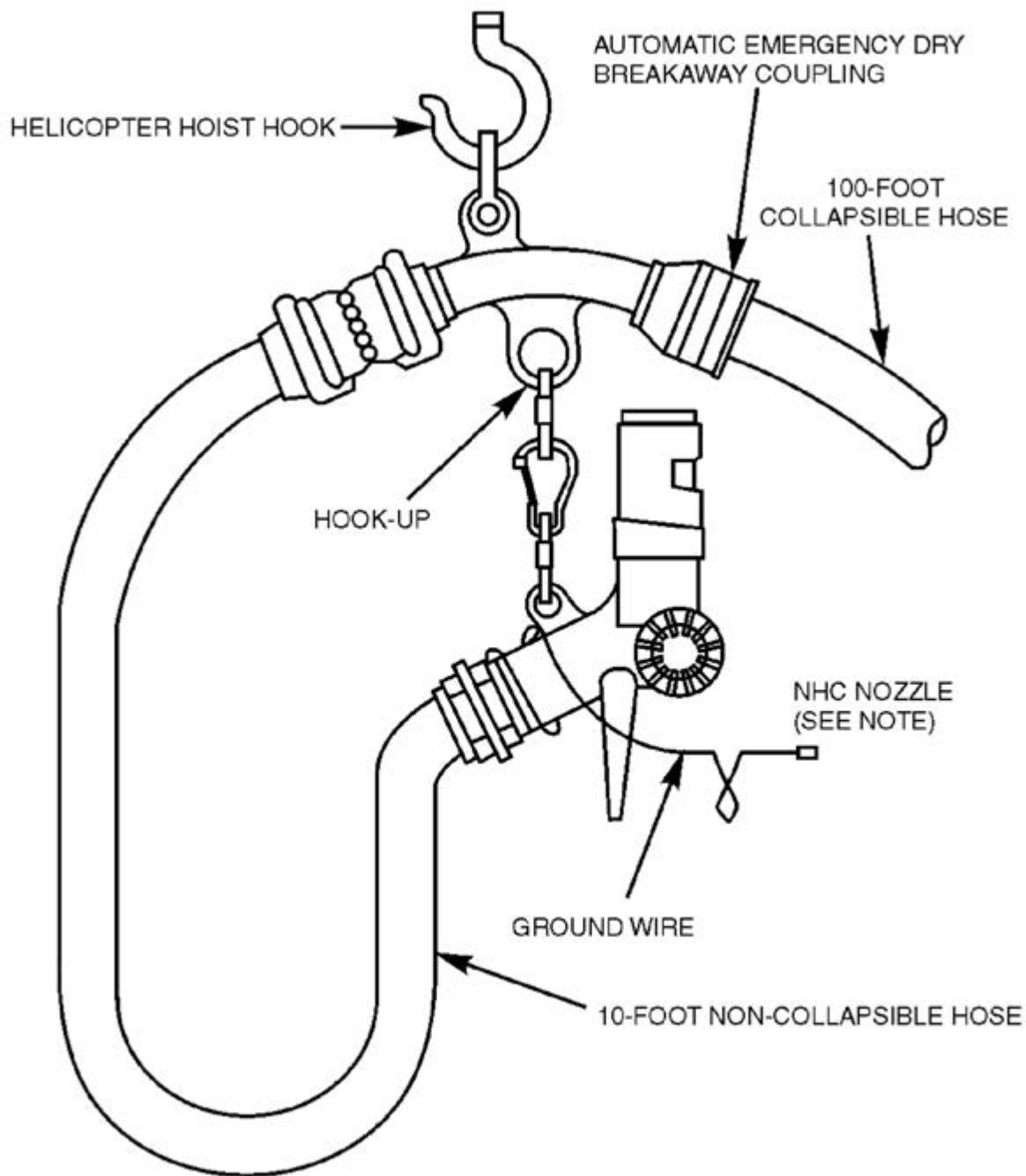
- X HOSE HANDLER
- △ HOSE FITTING SECURED TO DECK
- ⊗ FUEL STATION
- 10' HOSE SADDLE AND NOZZLE
- H HIFR DECK MARKING
- Λ GROUNDING PERSONNEL
- = COLLAPSIBLE HOSE
- NON COLLAPSIBLE HOSE

Refuel-F008a





Figure 6-5. NATO High Capacity Assembly Attached to Helicopter Hoist Hook



NOTE: FOR REFUELING NATO HELICOPTERS REPLACE WITH D-1 NOZZLE





6.2.9 Defueling Aircraft

WARNING

Only approved equipment and procedures shall be used by qualified personnel to defuel aircraft.

Note

During any defuel evolution, on the flight deck a mobile firefighting vehicle shall be manned upwind of aircraft involved. In the hangar bay an AFFF station shall be manned by V3 personnel.

On CVN and amphibious assault aviation ships defuelings normally have lower priority than refuelings. Unless otherwise directed and if they are not of an emergency nature, defuelings will be by written request approved by the Aircraft Handling Officer (ACHO) (does not apply to air-capable ships). A defuel request for an aircraft that is leaking fuel shall be considered an emergency and handled promptly.

The following rules apply to every defueling operation:

1. Aircraft defueling shall be requested by an authorized representative of the squadron's CO completing and submitting an Aircraft Defueling Certificate (Figure 6-6) to the ACHO via the Aviation Fuels Maintenance Officer.
2. During defueling operations, no other maintenance not directly required to facilitate the defueling operation shall be performed and engines shall not be running.
3. All fuel removed from turbine engined aircraft shall be assumed to be low flash point fuel. Defueled turbine fuel shall therefore not be returned to JP-5 storage tanks without first confirming the flash point of the fuel to be 140 °F or higher.
4. V-4 maintenance officer will verify on defueling certificate that fuel on aircraft designated to be defueled has been checked visually for sediment/particulates, free water, dye and tested for flashpoint. Ultimate disposition of fuel will depend on results of these tests.

WARNING

Fuel with a flashpoint below 140 °F shall not be defueled into the ship's storage tank. These systems are not designed to handle fuel with a lower flash point. The risk of explosion and/or fire will significantly increase if fuel with a low flash point is placed in these systems.

Note

Fuel containing leak detection dye shall not be returned to a ship's system.

5. For systems where an automated sampling device is installed and shared by two or more station hoses, after the hose used to defuel has been manually sampled and tested, then all hoses assigned to that automated sampling device and shall be flushed until real-time fuel quality output at the specific location is displayed and recorded on the ship's data acquisition system or manually entered by the applicable operator. Manual sampling may be used as a back-up to the automated sampling device, where the situation dictates.



**WARNING**

If the nozzle strainer is not checked and the Quality Surveillance test (manual sampling) is not run then contaminated fuel can be delivered to the aircraft potentially damaging the aircraft fuel system.

Note

Because of changing system designs and operational necessity, some aircraft refueling station hoses have been designated as a dual purpose refueling and defueling hose. Regardless of the type of hose it is, collapsible, non-collapsible, MIL-17902 or MIL-370, inch and a half or two and a half inch size, any dual purpose hose used to defuel an aircraft, prior to being used to refuel aircraft, shall first have the nozzle strainer checked IAW PMS and be flushed until Quality Surveillance tests indicate the fuel is acceptable to be issued to aircraft. Manual sampling shall be used since the affected hose is located downstream of that station's automated sampling device.

6. If during the defuel operation the pump starts to lose prime or cavitate, the operation will be discontinued until the problem is resolved.
7. A special log of each defueling operation shall be maintained. The following minimum information shall be contained in the log:
 - a. All abnormal happenings.
 - b. Aircraft side number.
 - c. Station/portable defuel.
 - d. Amount of product actually defueled.
 - e. Disposition of product.
 - f. Time/date of the day when the defuel operation was started and completed.
 - g. Name of defuel operator and squadron personnel present during the defuel operation.
8. Defueling crews shall wear safety clothing and goggles.
9. Plane captains shall be at their aircraft, and aircraft engines stopped. Secure all electronic and electrical switches not required for defueling.
10. Ensure aircraft is chocked and appropriate numbers of tiedowns are applied.

Note

Procedures provided are for the defueling of JP-5 grade fuel from an aircraft back to ship's existing aviation fuel system. If flash point test determines that aircraft has other than JP-5 fuel, and that the fuel cannot be commingled with existing ship's fuel, the commanding officer will be contacted and will make a determination on fuel disposition.





Figure 6-6. Aircraft Defueling Certificate

AIRCRAFT DEFUEL REQUEST	
Date: _____	Time: _____
1. Squadron: _____ A/C Side Number: _____ Tanks to be Defueled: _____ Present Fuel Weight in Tank to be Defueled: _____ Discrepancy: _____ Submitted by: _____ Approved by: _____ CVW MAINTENANCE CHIEF	
2. Fuel samples are required from ALL aircraft tanks to be defueled. Squadron REP, and AIR DEPT, and AV/FUELS REP are responsible. SAMPLE RESULTS: (A) FUEL TYPE: _____ (B) FUEL QUALITY (VISUAL): _____ (C) FUEL FLASHPOINT: _____ (D) DATE/TIME TAKEN: _____ (E) REMARKS: _____ APPROVED BY: _____ V-4 DIVISION QS REP. APPROVED BY: _____ AVIATION FUELS MAINTENANCE OFFICER APPROVED BY: _____ AIRCRAFT HANDLING OFFICER	
3. DEFUEL TO BE PERFORMED BY AV/FUELS REPAIR TEAM ONLY. Date/Time Defuel Commenced: _____ Completed: _____ Amount Defueled: _____ Fueling Hose Flush Sample Results: MG/L _____ PPM _____ Remarks: _____ _____ _____	
REPAIRMAN-IN-CHARGE: _____	





6.2.9.1 Defueling with Installed Station Defuel Pump

WARNING

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

Perform the defuel operation as follows:

1. Attach grounding cable from the deck to the aircraft.
2. Unreel the hard hose and lead to aircraft to be defueled.
3. Ensure quick disconnect continuity switch is in OFF (defuel) position.
4. Remove SPR receptacle cap from the aircraft.
5. Remove the dust cover from the SPR (D-1) nozzle.
6. Lift nozzle by lifting handles, align the lugs on the nozzle with the slots on the aircraft adapter and hook up the nozzle to the aircraft by pressing it firmly onto the adapter and rotating it clockwise to a positive stop.

WARNING

Nozzle must seat firmly on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system that can lead to a fuel spray or spill.

Note

Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. A defective or worn aircraft SPR can also be detected in this manner.

7. Open station defuel valve.
8. Start defuel pump.
9. Defuel aircraft as directed.
10. Rotate the nozzle flow control handle to the full open position. (The handle shall rotate 180 degrees to ensure the poppet valve is fully locked open.)
11. When defueling is complete, shut the nozzle valve by rotating nozzle flow control handle 180 degrees to the locked shut position.
12. Stop defuel pump and shut defuel valve.
13. Disconnect nozzle from aircraft.
14. Replace nozzle receptacle (adapter) cap on aircraft.
15. Replace dust cover on the SPR nozzle.
16. Remove ground wire from aircraft, then metal deck.
17. Restow hose.
18. Finalize and sign section 3 of Aircraft Defuel Request. Deliver chit to flight deck control talker.





6.2.9.2 Defueling with a Portable Defuel Cart

WARNING

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

1. Aircraft handling officer will designate location where aircraft is to be defueled.
2. Ensure following V-4 crew members are on station:
 - a. Two nozzle operators.
 - b. Two safety men.
 - c. One defuel cart operator.
3. Ensure there is means of communication between the defueling crew and the Flight Deck Control Talker.
4. Position defuel cart in proximity to designated aircraft and to defuel destination location.
5. Secure cart to deck with tiedown chains.
6. Securely connect low pressure air hoses and fittings between ship's air supply outlet and air inlet connection on defuel cart pump.
7. Connect ground wire to metal deck then to defuel cart.
8. Unreel the defuel cart suction hose and position near the aircraft to be defueled.
9. Unreel the defuel cart discharge hose and position near the station flushing connection.
10. Connect ground wires to metal deck then to designated aircraft.
11. Remove the SPR receptacle cap from aircraft pressure fuel adapter and the station flushing connection.
12. Remove suction nozzle dust cover and align the lugs on the nozzle with the slots on aircraft pressure fuel adapter. Press nozzle firmly into adapter and ensure all three nozzle lock keys are depressed.
13. Rotate nozzle clockwise to a positive stop.
14. Remove discharge nozzle dust cover and align the lugs on the nozzle with the slots on the station flushing connection. Press nozzle firmly into flushing connection and ensure all three nozzle lock keys are depressed.
15. Rotate nozzle clockwise to positive stop.
16. Open applicable station flushing connection valve.
17. Rotate both the nozzle flow control handles to the full open position.
18. Verify there is air pressure at ships LP air supply outlet and slowly open air supply valve.
19. Notify flight deck control talker that defuel operation has commenced.
20. Have plane captain verify designated aircraft tank(s) are being defueled.
21. When defuel is complete secure operation.
22. Shut air supply valve to air inlet connection on defuel pump.
23. Shut both defuel cart suction and discharge nozzles by rotating handles to full shut position.
24. Shut the applicable station flushing connection valve.
25. Disconnect air hose from air supply to defuel cart.





26. Disconnect nozzles from aircraft and station flushing connection and replace both dust covers.
27. Replace the SPR receptacle adapter caps on aircraft and station flushing connection.
28. Report aircraft defuel complete.
29. Remove ground wire from aircraft, then metal deck.
30. Rewind hoses on defuel cart hose reels.
31. Remove ground wire from defuel cart then metal deck.
32. Remove chains and move defuel cart to stowage location.
33. Finalize and sign section 3 of Aircraft Defuel Request. Deliver chit to flight deck control talker.

6.2.9.3 Defueling with Overwing Nozzle

WARNING

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

Perform the defuel operation as follows:

Note

- If a gravity nozzle is to be used to defuel a drop tank or other similar vessel, the nozzle must first be outfitted with a short length of hose. The bottom of this hose must have notches so that suction is not impeded.
 - Shipboard suction defueling of OH-58D aircraft is not possible using a section of 1-1/2 inch or larger fuel hose, as those hoses are too large to fit through the aircraft's gravity fuel filler port. A defueling adapter with a smaller outer diameter hose will be required.
1. Attach grounding cable from the deck to the aircraft.
 2. Unreel the hard hose and lead to aircraft to be defueled.
 3. Ensure quick disconnect continuity switch is in OFF (defuel) position (does not apply to air-capable ships).
 4. Bond the overwing nozzle to the aircraft as shown in [Figure 6-1](#) and then remove the filler cap from the aircraft/tank.

WARNING

Always bond the nozzle to the aircraft before the fill cap is removed. This connection shall remain in place until the entire defueling operation is complete. Failure to bond nozzle and/or maintain contact can result in a dangerous static spark inside the fuel tank.

5. Remove dust cover and insert overwing nozzle in the aircraft/tank refueling port and maintain metal to metal contact between the overwing nozzle and the aircraft/tank refueling port throughout the entire defueling operation.
6. Open station defuel valve.
7. Start defuel pump.





8. Open overwing nozzle.
9. Defuel aircraft/tank as directed.

WARNING

Self closing nozzles shall not be blocked open or bypassed. This defeats the purpose of the device and can lead to a catastrophic accident.

10. When defuel is complete secure operation. Close overwing nozzle.
11. Stop defuel pump and shut defuel valve.
12. Disconnect nozzle from aircraft and reinstall dust cover.
13. Replace cap on drop tank.
14. Disconnect nozzle bond wire.
15. Remove ground wire from aircraft, then metal deck.
16. Restow hose.

6.2.10 Handling of Aircraft Containing Fuel Other Than JP-5

Aircraft that have been either land-based or aerial refueled by USAF, USA, commercial airport, or other equipment/facilities shall be assumed to contain fuel other than JP-5 in their tanks. The following precautions apply:

1. Aircraft recovering aboard the ship with mixed fuels shall notify the first available ship's controlling authority (strike, marshal, PriFly/tower) prior to recovery.
2. On deck, identification of aircraft containing fuel other than JP-5 shall be as prescribed by the flight deck officer. Identification of fuel other than JP-5 shall be maintained until it has been certified that the flashpoint is 120 °F or higher. Aircraft shall be refueled with JP-5 as soon as possible.
3. Every effort should be made not to park aircraft with low flash point fuels on hot catapult tracks.
4. Prior to any defuel operation the aviation fuels officer shall ensure the fuel being removed is of satisfactory flash point for shipboard storage.

WARNING

Fuel with a flashpoint below 140 °F shall not be defueled into ship's storage tank. Shipboard aviation fuel systems are not designed to handle fuel with a lower flash point. The risk of explosion and/or fire will significantly increase if fuel with a low flash point is placed in these systems.

6.2.10.1 Hangaring of Aircraft Containing Fuel Other Than JP-5

If, for any reason, an aircraft containing fuel with a suspected low flash point must be moved to the hangar deck, fuel samples must be taken from all low point drains of the aircraft and their flash points measured. If the flash point of any sample is found to be below 140 °F but all samples test above 120 °F, the aircraft can be lowered to the hangar deck with the following precautions:

1. All hangar bay sprinkling groups located in the hangar bay in which the aircraft are parked shall be operable.
2. CONFLAG station located in the hangar bay with the affected aircraft shall be manned (does not apply to air-capable ships).





- Hot work shall not be conducted in the hangar bay or in close proximity to the hangar bay containing the affected aircraft.

6.2.10.2 Use of Plane-to-Plane Transfer Cart to Transfer Low Flashpoint Fuels Between Aircraft

The primary method of increasing the flashpoint of fuel above 120 °F in an aircraft that has land or aerial refueled with other than JP-5 fuel is to refuel the aircraft with JP-5. If this is impractical or undesirable the preferred method of removing the fuel is to use the Plane-to-Plane Transfer Cart. This cart comprises two hose reel assemblies with SPR nozzles, an air-operated pump, two Velcon Aquacon filter units, and a deadman control. The cart belongs to the V-4 division. Requests for plane-to-plane fuel transfers shall be made from the squadron level to the ACHO via the aviation fuels officer.

6.2.10.2.1 Procedures

The purpose of the Plane-to-Plane Transfer Cart ([Figure 6-7](#)) is to safely transfer low flashpoint fuel and fuel suspected of containing thermal stability additives between aircraft.

- Submit approved fuel transfer request to the aircraft handling officer and fuels officer. See [Figure 6-8](#).

WARNING

- Hot refueling of aircraft using the Plane-to-Plane Transfer Cart is not authorized.
- Defueling of aircraft into the ship's fuel storage system using the Plane-to-Plane Transfer Cart is not authorized.
- Engines of aircraft involved in fuel transfer shall not be started while hoses are connected to aircraft.

Note

- Ensure issuing and receiving aircraft are positioned close to each other.
 - Ensure aircraft are securely chocked and tied down.
 - Ensure all aircraft electrical and electronic switches not required for the transfer operation are turned off.
 - Ensure aircraft low point drains have been drained of water and solids prior to commencing transfer operations.
- Conduct fuel flash point test on issuing aircraft, and record results.
 - Verify all maintenance requirements for transfer cart and components are current. Inspect low pressure air manifold lubricator for proper oil level.
 - Securely connect low pressure air hoses and fittings between air supply outlet and transfer cart inlet manifold.
 - Position transfer cart between aircraft.
 - Secure and ground cart to deck.
 - Ensure mobile firefighting unit is present.
 - Inspect and verify area is free of open flames or spark-producing devices.
 - Ensure transfer detail and plane captains are present.
 - Inspect nozzles and quick-disconnect couplings for secure fit prior to attaching to aircraft.
 - Unreel and inspect entire length of suction and discharge hoses. Verify hose integrity.





12. Visually inspect aircraft adapters for any damage or significant wear. Attach nozzles and grounding wires to each aircraft.

WARNING

Ensure nozzle is seated firmly on the adapter and is not cocked.

13. Inspect nozzles and aircraft receptacles for leakage.
14. Open air supply outlet valve.
15. Open transfer cart air manifold valve.
16. Verify air pressure is sufficient. (Adjust air pressure via regulator to 80 psi; not to exceed 100 psi.)
17. Open pump discharge valve.
18. When both nozzle operators and plane captains are ready, open nozzle flow control handles to the FULL OPEN position. Handles shall rotate 180 degrees to ensure the poppet valve is fully open and locked.
19. Deadman operator activates deadman to commence transfer operation.
20. When directed by the plane captain, deadman operator will release the deadman to stop the transfer operation.
21. When the transfer operation is completed, rotate the nozzle's flow control handles into the OFF and fully locked position.
22. Close pump discharge valve.
23. Remove nozzles from aircraft, stow hose, shut air supply outlet and transfer cart air manifold valves, disconnect cart from air supply, and stow cart in designated location.

Figure 6-7. Plane-to-Plane Transfer Cart

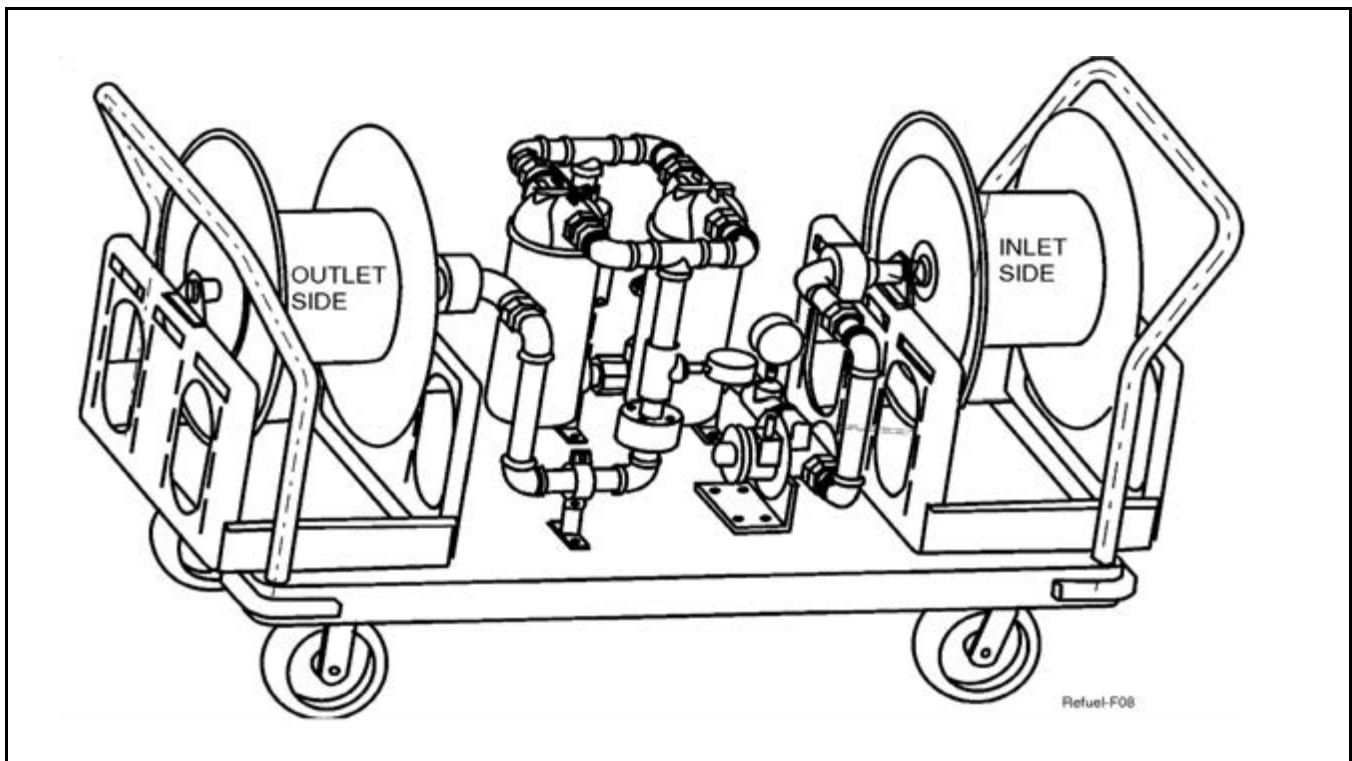




Figure 6-8. Aircraft-to-Aircraft Mixed Fuel Transfer Certificate

Date: _____ Time: _____	
1. Squadron: _____ A/C Side Number: _____	
Tanks to be Defueled: _____	
Present Fuel Weight in Tank to be Defueled: _____	
Maintenance Discrepancy: _____	
Receiving Aircraft Side Number: _____	
Present Fuel Weight of Receiving Aircraft: _____	
Approved by: _____ CVW MAINTENANCE CHIEF	
2. Fuel samples are required from ALL aircraft tanks to be defueled. Squadron REP, and AIR DEPT, and AV/FUELS REP are responsible.	
SAMPLE RESULTS: (A) FUEL TYPE: _____	
(B) FUEL QUALITY: _____	
(C) DATE/TIME TAKEN: _____	
(D) FLASHPOINT: _____	
(E) LOW POINT DRAINS VISUAL INSPECTION: _____	
(F) REMARKS: _____	
APPROVED BY: _____ V-4 DIVISION QS REP.	
APPROVED BY: _____ AVIATION FUELS MAINTENANCE OFFICER	
APPROVED BY: _____ AIRCRAFT HANDLING OFFICER	
3. TRANSFER OPERATION TO BE PERFORMED BY QUALIFIED TRANSFER CART TEAM ONLY	
Date/Time Transfer Commenced: _____ Completed: _____	
Amount Transferred: _____	
Flash Point of Receiving Aircraft upon Completion _____	
Remarks: _____	





6.2.10.2.2 Taking of Fuel Samples During Fuel Transfer Operation

During the fuel transfer operation, take fuel samples as follows:

1. From the nozzle attached to the receiving aircraft after flow is established.
2. From the low points of the receiving aircraft after the transfer operation is completed.

These samples shall be tested for visual appearance and flashpoint. Results of these tests shall be entered into the quality surveillance fuel sample log shown in [Figure A-6](#).

6.2.11 Handling NATO F-37 (JP-8+100) and F-27 (F-24+100) Fuel

NATO F-37 (JP-8+100)/F-27 (F-24+100) is NATO F-34 (JP-8)/F-24 which has been additized with a thermal stability improving additive. The thermal stability additive is a dispersant/detergent that:

1. Disarms filter-coalescer elements.
2. Adversely affects the ability of centrifugal purifiers to remove free water and sediment/particulates from aviation turbine fuel.
3. Makes free water readings taken with the digital free water detector unreliable.

It is possible that transient USN/USMC aircraft may receive NATO F-37/F-27 inadvertently when conducting joint operations requiring refueling from ashore air stations operated by the USAF, US Army and NATO member air forces that utilize NATO F-37/F-27.

Note

NATO F-37/F-27 is not authorized for use in USAF or other NATO member nations' aerial refueling aircraft.

If aircraft are suspected of having received NATO F-37/F-27 and need to be defueled, the following handling procedures, in addition to those contained in [paragraphs 6.2.10](#) and [6.2.10.1](#), apply:

WARNING

Do not, under any circumstances, place NATO F-37/F-27 in a ship's aviation fuel storage/delivery system.

1. Use plane-to-plane transfer cart to transfer NATO F-37/F-27 fuel between aircraft.
2. If a plane-to-plane transfer cart is unavailable, NATO F-37/F-27 fuel shall be treated as hazardous waste and handled accordingly.

Aircraft which are suspected of having received NATO F-37/F-27 fuel from any source are safe for defueling directly to ships aviation fuel storage tanks only after refueling three times with a full usable internal fuel load of NATO F-44 (JP-5).

TYCOMs and AIR-4.4.5 shall be notified via naval message of any actual/suspected NATO F-37/F-27 defueling.

6.2.12 Precertification Refueling

Note

Refueling of DOD aircraft, NATO aircraft and other authorized civilian aircraft, using installed shipboard aviation fuel systems, shall only be accomplished under the authority of a current aviation fuel system certification or waiver of certification.





Aboard CVN class ships, PEO carriers has authorized the use of the JP-5 auxiliary service system, in conjunction with specific additional equipment, to provide an emergent means of refueling helicopters prior to achieving a full aviation fuel system certification (restricted or unrestricted). These types of refueling operations shall only be conducted in order to support aircraft directly engaged in Search And Rescue (SAR), Medical Evacuation (MEDIVAC) operations and critical logistics missions. The intent of this temporary manner of refueling is not to support normal refueling operations and shall only be conducted in the presence of the certifying authority (NAVAIR) representative during the Aviation Fuel Facilities Certification process. These procedures will be discussed in detail during the 30-day commanding officer's pre-certification brief as required by the Aircraft Carrier Aviation Fuel Facilities Certification Checklist (NIMITZ Class: Report NAEC-AWS-51-870 or FORD Class: NAWCADLKE-MISC-482500-0509). It is highly recommended that Fuels Maintenance Officers contact their applicable TYCOM representative and NAVAIR Carrier and Field Service Unit (CAFSU) representatives 90 days prior to certification to establish a clear line of communication regarding certification expectations and concerns.

Refueling of aircraft from any other installed refueling station hose prior to the completion of a full aviation fuel facilities certification and release of the certification message by the inspection team leader (NAVAIR) is not authorized.

Note

Hot refueling is not authorized when utilizing the precertification auxiliary refueling rig.

6.2.13 Shipboard Refueling Procedures for Commercial Contract Helicopters

Note

The SPR adapter must be permanently installed on aircraft.

Commercial contract helicopters are being used more frequently to provide logistical support to fleet units. All refueling procedures contained in this chapter apply to the refueling of commercial helicopters on US naval vessels with the following modifications:

1. Cold refueling of commercial helicopters. Cold refueling shall be performed by the use of a gravity nozzle or, if the helicopter equipped with either a SPR or CCR fueling adapter, by a D-1 or 15-psi regulated CCR nozzle. All commercial helicopters equipped with SPR or CCR fueling adapters are also capable of being gravity refueled.
2. Hot refueling of commercial helicopters. Hot refueling of commercial helicopters is only authorized if such helicopters are equipped with either SPR or CCR fueling adapters. If a commercial helicopter is equipped with a CCR fueling adapter it shall only be hot refueled using a 15-psi regulated CCR nozzle.
3. Since 15-psi regulated CCR nozzles are not authorized ship's force equipment, any commercial helicopter operator desiring to refuel onboard US naval vessels by means of the CCR fueling adapter will need to provide the necessary 15-psi regulated CCR nozzles and the adapters necessary to mate with the ship's hoses.

6.2.14 Support of Aircraft Inflight Refueling Probe Maintenance

Aircraft Inflight Refueling (IFR) probes periodically require pressure testing for maintenance purposes. Such IFR probe pressure testing is accomplished using aircraft T/M/S specific maintenance procedures. Aviation fueling equipment and fuel are required to support these periodic maintenance evolutions; however, routine refueling, cold or hot, of aircraft via the IFR probe shall not be permitted.



Providing fuel to aircraft via the IFR probe increases the risk of fuel spills.





CHAPTER 7

Shipboard Preventive Maintenance

Ship's personnel shall follow appropriate OPNAV, NAVSEA, and TYCOM Manuals and Instructions for equipment and systems maintenance.





PART III

Aircraft Refueling at Shore Activities

Chapter 8 — Organization and Training at Shore Activities

Chapter 9 — Quality Surveillance of Aviation Fuels
at Shore Activities

Chapter 10 — Safety in Shore Activity Fuel Handling
Operations

Chapter 11 — Shore Activity Facilities and Equipment

Chapter 12 — Operating Procedures for Shore Activities

Chapter 13 — Maintenance of Refueling Facilities
at Shore Activities





CHAPTER 8

Organization and Training at Shore Activities

8.1 ORGANIZATION

The effectiveness of any complex operation is dependent on a well-structured organization with qualified and knowledgeable supervision. The cost of fuel, fuel facilities, and equipment and hazards of fuel operations are a few of the critical factors that shall be considered in the development of a fuel organization. It is these factors coupled with the essential part aircraft refueling plays in flight operations that justifies Division status for the integrated fuel operation.

Navy and Marine Corps shore activities are urged to use the standard organization for integrated fuel operations shown in [Figure 8-1](#). At GOCO Facilities the standard organization chart shown in [Figure 8-2](#) should be used.

The allowances for a fuel division should include personnel in adequate quantities and with sufficient grade structure, training, and seniority to ensure responsible operation of facilities and equipment in response to the maximum projected operational demand. Navy personnel with the Aviation Boatswain's Mate Fuels (ABF) rating and civil service (shore facilities) personnel allowances should be primarily validated and documented based on past experience. The airfield's classification, aircraft base loading (including any planned changes), and general daily tempo of operations must also be considered.

The organization should be flexible enough to efficiently handle increased workload on short notice. This can best be accomplished by cross-training and cross-manning (i.e., truck refueler driver/operators should also be trained to operate direct refueling stations). Leave schedules and school attendance can be adjusted to accommodate workload peaks. Lengthening working shifts (recommended not to exceed 10 hours) and nonstandard duty sections, including standby duty section assignments, should be last-resort measures.

The functional heads (Fuel Management Officer [FMO] and Assistant Fuel Management Officer [AFMO]) of the integrated fuel operations shall:

1. Possess broad fuel background and experience (e.g., formal training and experience in the technical area of fuel operations and handling).
2. Be full-time primary assignments.
3. Be graded positions, if civilian.
4. Carry delegated authority commensurate with responsibility.
5. Report directly to locally designated authority.

8.1.1 Responsibilities

At shore activities the DLA Energy appointed Terminal Manager (TM), Responsible Officer (RO) or Property Administrator (PA) (DESC-P-7) is normally assigned responsible for budgeting, receipt, storage, accountability, issue, quality surveillance, and environmental impact of petroleum products. General, preventive maintenance of Petroleum Oil Lubricants (POLs) handling, storage, and delivery systems is an integral part of this responsibility.

The FMO discharges the officer's fuel responsibilities through the planning, directing, training, and supervision of a completely integrated fuel operation.

Aircraft custodians are responsible for training nozzle operators, aircraft directors, and fire watches for aircraft refuelings and defuelings. The nozzle operator shall assist the refueler operator in handling the hose and nozzle prior to, and after, the servicing of aircraft in order to minimize hose wear and nozzle damage due to dragging.





Note

Transient aircraft will be refueled by personnel identified by local instruction in compliance with this directive.

Air operations officer is responsible for establishing priorities for aircraft fuel delivery services. In addition, shore activity air operations officers are responsible for providing input to the activity's fuel instruction pertaining to operating procedures on the parking aprons and ramp areas, aviation safety, and any peculiar requirements for unique, seldom handled, or new aircraft.

The FMO is responsible for identifying all corrective repair actions on fuel infrastructure that must be accomplished by personnel outside of the immediate fuels organization. The FMO must coordinate with the PW or other appropriate agency to develop projects on a DD Form 1391 and submit them to the Service Control Point and DLA Energy for approval and funding via the SRM-E program. The FMO must also develop and coordinate, with the appropriate activity official(s), a preventive maintenance program that addresses all fuel storage facilities and dispensing equipment including tanks, fill stands, piping valves, pumps, electrical installations, and mobile and fixed refuelers. Grass cutting and general area maintenance around the fuel farm in all but the hazardous areas, around fuel vents, and fenced areas, must also be coordinated with the appropriate official. It is also the FMO's responsibility to initiate and monitor necessary military construction and other fuel related projects by submitting them to the PWO or other appropriate activity official.

The PWO/environmental officer/hazardous material officer is responsible for coordinating oil spill cleanup with fuel personnel.

8.1.2 Duties

Refer to MIL-HDBK-844B(AS) for a detailed discussion of the various specific duties of the FMO, AFMO, and other officers and personnel of the fuel division.

Figure 8-1. Typical Shore Activity Organization

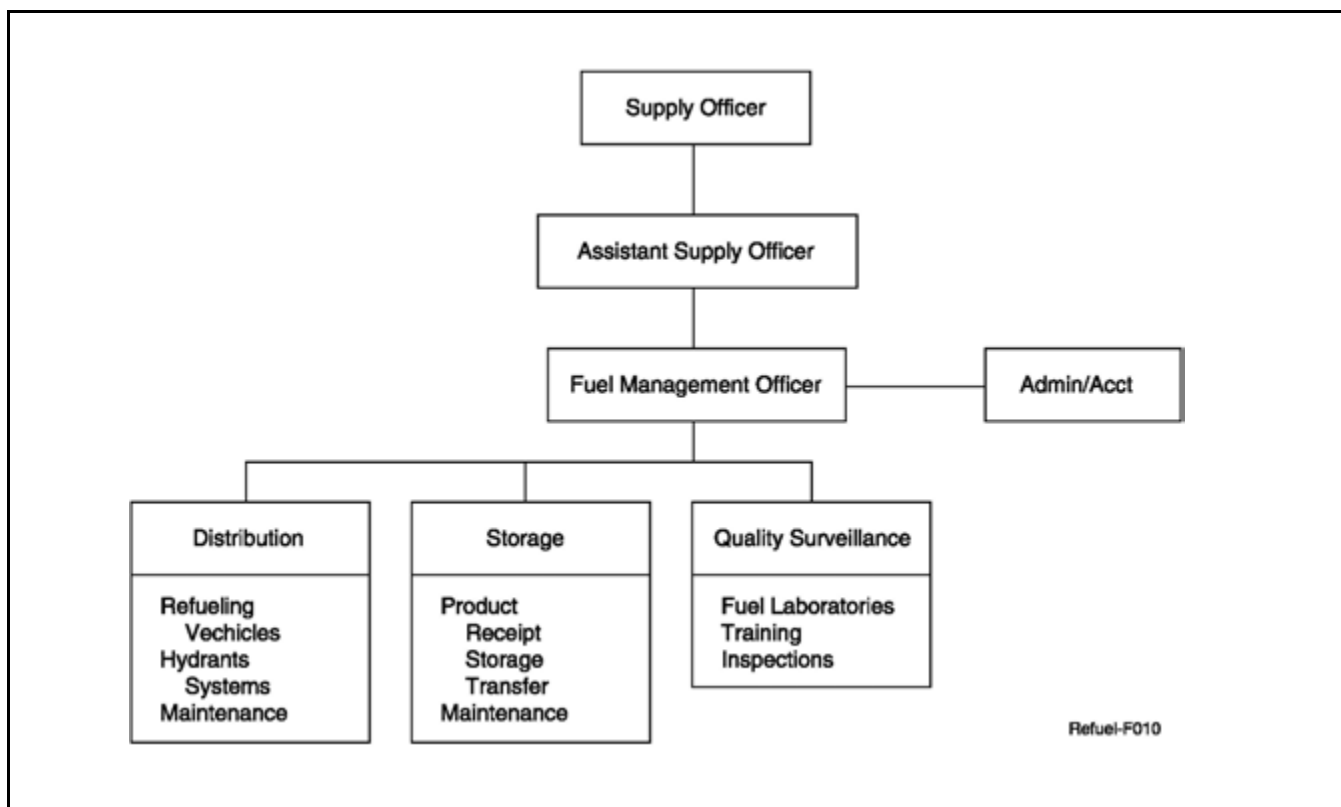
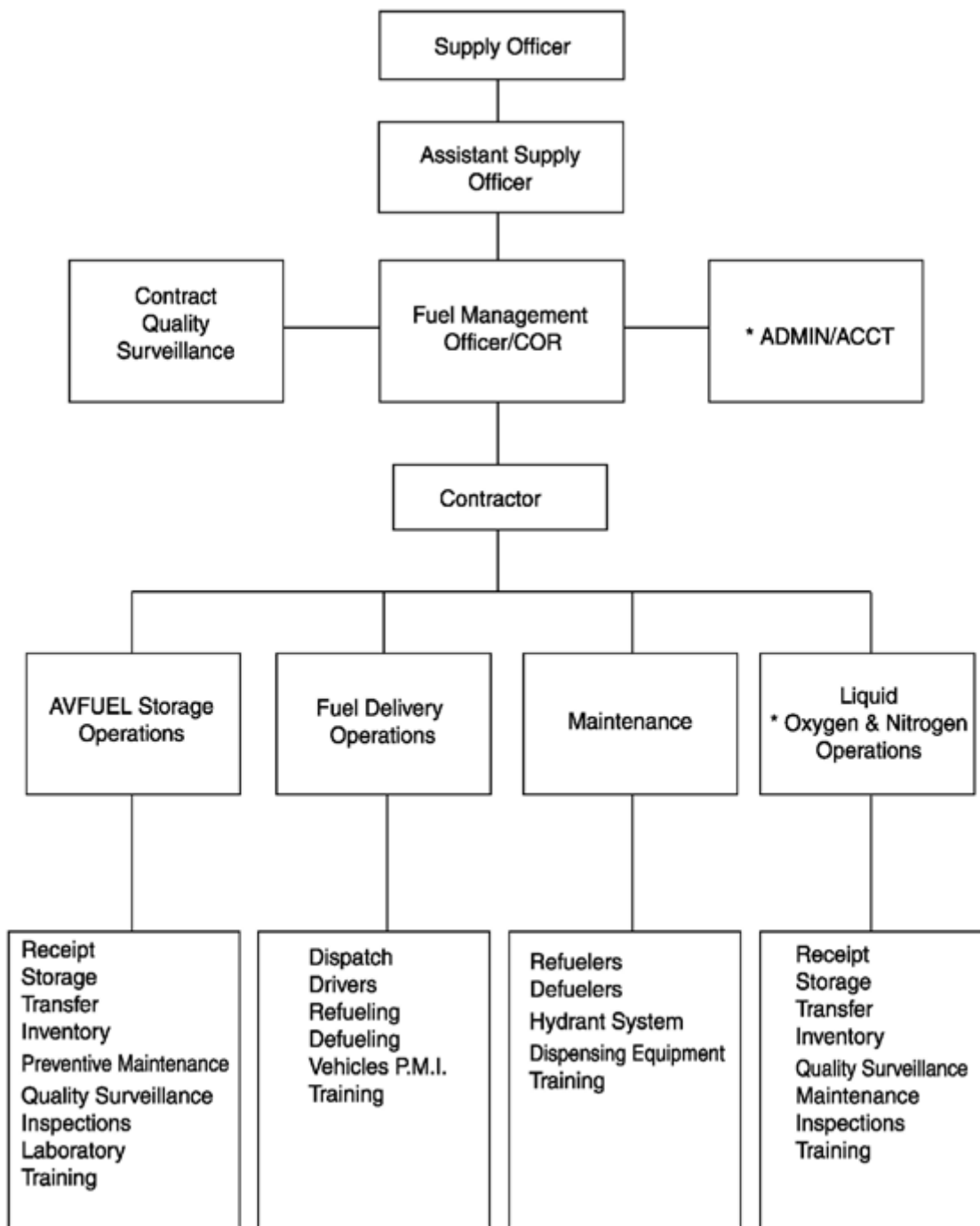




Figure 8-2. Typical Government Owned Contractor Operated Facility



* All of these functions, may or may not be contracted.

Refuel-F011





8.2 TRAINING REQUIREMENTS

8.2.1 General Training Requirements

It is essential to the safety of fuel handling operations that personnel be properly trained. Only those personnel possessing the ABF rating or qualified in accordance with the current MOS manual for MOS 1390, 1391, 3534 shall be involved in aircraft refueling operations from source to nozzle.

All Contracting Officers' Representatives (CORs) shall be properly trained and qualified in contract administration. As a minimum, all CORs shall receive 80 hours of formal classroom instruction prior to assuming COR duties and responsibilities. Contact the NAVSUP Energy Office for recommended courses and training.

Contractor employees performing fuel duties shall be company trained and certified. Certification shall include a written or oral examination as well as direct observation of the employee performing the certified duties. Records of training and certifications shall be maintained. The COR shall verify training and certification have been accomplished.

All personnel shall be trained via the following minimum steps:

1. An informal course in which the contents of this manual, MIL-HDBK-844B(AS), UNIFIED FACILITIES CRITERIA (UFC) 3-460-03 Operation and Maintenance: Maintenance of Petroleum Fuel Systems are taught. The course shall be developed to emphasize safety and procedural requirements contained in these manuals and how they apply to the local facilities, equipment, and operations. Personnel shall be required to demonstrate their acquired knowledge.
2. A series of apprenticeship programs (On-The-Job Training [OJT]) for each major system to be operated; for example, direct refueling system, refueling truck, truck fill stand, and fuel transfer system. The novice operator shall be instructed on the system's operation using the operating instruction manuals. Afterward, a certified, experienced operator shall demonstrate the system's operation to the novice. The student shall then operate the system under the supervision of an experienced operator who will ultimately certify that the student has acquired the knowledge necessary to correctly and safely operate the system. The length of time each apprenticeship program takes will depend on the complexity of the system being taught as well as the abilities of the student. All activities are required to maintain a formal document that outlines the apprenticeship program covering each major system. This outline must contain details on instructional materials used (operating manuals and local operating instructions) as well as the minimum experience (time) requirements for obtaining certification. As a minimum, these apprenticeship programs shall follow the PQS for Fuel Operations Ashore, NAVEDTRA 43288. This will assist each student in establishing long- or short-term goals for qualifications.

All drivers of refueling or defueling vehicles shall attend an airfield indoctrination course as outlined in NAVAIR 00-80T-124.

8.2.2 Refueling Vehicle Operator Certification

Active duty military and civil service drivers shall carry a current Optional Form 346 (OF-346) U.S. Government Motor Vehicle Operator's Identification Card and comply with the requirements delineated in NAVFAC P-300, Management of Transportation Equipment. In addition, driver training and certification must comply with all applicable local, state and Federal laws. DoD contractor personnel assigned to operate either government owned/leased motor vehicles shall be certified by the contractor as being fully qualified to operate the vehicles. As a minimum, drivers shall be licensed for the class vehicles they are operating and shall comply with the licensing requirements of the local activity.

8.2.3 Nozzle Operators' Training and Certification

Nozzle operators shall be thoroughly trained and certified in accordance with the applicable directives for the type, model, and series of aircraft being refueled. This training shall result in the nozzle operator possessing a thorough working knowledge of the aircraft's fuel system including the following specific items:

1. Aircraft's ground refueling panel.





2. Precheck system.
3. Location and operation of any switches that control the flow of fuel into the various tanks of the aircraft.
4. Locations of the aircraft's fuel system vents.
5. Mechanism(s) by which the pressures within aircraft tanks must be monitored (to prevent overpressurization).
6. Mechanism(s) by which the tank loading status (e.g., full, partial, no load) can be monitored.





CHAPTER 9

Quality Surveillance of Aviation Fuels at Shore Activities

9.1 GENERAL REQUIREMENTS

The major objective of fuel handling personnel is to deliver clean, dry, 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. In addition, aircraft engine failure or poor performance may also be caused by incorrect fuel or by contamination of the proper fuel with other petroleum products or materials. Refer to MIL-HDBK-844B(AS) for a detailed discussion of the various types of fuel contaminants, their effects on the using equipment, and their possible sources.

The quality surveillance of aviation fuels is a continuous process. Every action such as transferring product from one tank to another or short-term storage in a poorly coated tank can introduce contaminants into the fuel. All local operating procedures shall therefore be written with this fact in mind. Sources of contamination must be recognized and eliminated. In addition, procedures must be in place to routinely monitor the quality of the fuel so that the presence of abnormal amounts of contaminants is identified and steps are taken to remove them.

DLA Energy has designated the fuel quality control efforts performed at the refinery or time of fuel purchase as “quality assurance.” All fuel quality control efforts performed after the fuel has been delivered to the Government are classified as “quality surveillance.” This chapter conforms to this policy.

This chapter outlines the absolute minimum steps that shall be taken in order to:

1. Monitor the quality of the fuel being handled and delivered to aircraft.
2. Control and minimize the introduction of typical contaminants (water and sediment/particulates).

The detailed operating procedures contained in [Chapter 12](#) and the maintenance procedures of [Chapter 13](#) incorporate many of these monitoring and quality surveillance steps. Any local operating instructions for specific systems or pieces of equipment shall also contain appropriate quality surveillance procedures.

9.2 AVIATION FUEL QUALITY SURVEILLANCE PROGRAM

All activities that refuel aircraft shall establish a formal written fuel quality surveillance program. Samples shall be taken from the refueling nozzle of each aircraft refueling system, vehicle, truck fill stand, etc., and tested using the CCFD and FWD. Visual inspections shall also be taken for spot checks. All activities shall record all test results in a log, similar to [Figure A-1](#) in [Appendix A](#), along with the date, approximate time, the source (tank, refueler filter/seperator, refueling nozzle, etc.) and other appropriate information. The Quality Module within the Fuels Manager Defense (FMD) program may be used to satisfy this requirement. This shall be done for visual as well as machine run tests. Such records shall be used to monitor equipment performance as well as to provide an audit trail.

The following paragraphs establish the minimum sampling and testing requirements for aviation fuels. They shall be treated as the minimum requirements and shall not preclude more frequent or extensive testing as required by MIL-STD-3004 or should contamination be suspected. MIL-STD-3004, contains analogous information regarding fuel sampling and testing requirements. This standard is produced jointly by DLA Energy and the three Services to provide instructions and guidance on the handling and testing of fuel within the Defense Logistics Agency’s supply and distribution system. In the event of a conflict between the requirements of this NATOPS Manual and MIL-STD-3004, this NATOPS Manual takes precedence. However, this does not preclude MIL-STD-3004 testing requirements.





9.2.1 Fuel Receipts

The following paragraphs contain the absolute minimum tests that shall be performed when receiving fuel at a shore activity.

WARNING

If for any reason it is suspected that the product being received has been significantly contaminated with other fuels, petroleum products, or other materials, a special sample shall be taken and a complete set of fuel specification tests shall be performed. Failure to identify and reject contaminated fuel can negatively affect aircraft safety-of-flight.

In addition to the routine samples that are immediately tested during fuel receipt, shore activities shall obtain a 1-gallon retention sample that is representative of the shipment. This sample shall be tagged, logged, and stored in an approved flammable storage cabinet and retained for 60 days or until one of the following conditions occur:

1. The product represented by the sample is consumed.
2. The product becomes nonrepresentative of the sample held.

9.2.1.1 Fuel Received by Tank Car or Tank Truck at Shore Stations

Take a sample from the conveyance tank before commencing off-loading. Check sample for color and appearance.

Ensure seals are intact and that the numbers correspond to those on the shipping document. After connections with receiving system have been made and fuel flow initiated, immediately take a sample from the manifold or coupling (nozzle) and conduct the following tests:

1. Color.
2. Appearance.
3. API gravity.

If the product is clear and bright in appearance and the API gravity is within 0.3 degrees of the shipping document (DD Form 250, Material Inspection and Receiving Report, or delivery invoice), receipt of the product shall be continued. A second sample shall then be taken and tested for:

1. Sediment/particulates (visual).
2. Free water (visual).
3. Flash point (JP-5, F-24 and JP-8 fuels only).
4. FSII (turbine fuels only).

An alternate procedure is to take an all-levels sample and conduct the above tests prior to initiating fuel flow.

If either manifold sample fails the test requirements, product receipt shall be halted and an all-levels sample shall be obtained from the tank car or tank truck compartment. In the case of excessive sediment/particulates or free water, the all-levels sample shall be tested using the CCFD and/or FWD as appropriate. If the resample contamination exceeds 2 mg/L solids or 10 ppm water and the product must be received, additional sampling and testing will be required downstream of the tank and filter separator to ensure contamination is reduced to acceptable levels through settling and filtration. If a repeat flash point failure occurs, notify the FMO and the Quality Assurance Representative (QAR) at the point of origin.



**Note**

In the case of compartmented vessels, all-levels samples shall be taken from each compartment.

For multiple receipts by tank car and tank truck from the same supplier, the same source (tank), and the same vessel (truck/tank car), only the first delivery of the day need be tested for flash point and a retention sample kept.

9.2.1.2 Fuel Received by Pipeline at Shore Stations

A line sample will be taken 1 minute after flow commences and checked for color, appearance, and gravity. If the product is clear and bright in appearance the flow will continue. The receiving tank will be segregated until further sampling and testing can be accomplished. An all-levels sample or a composite of upper, middle, and lower samples will be used. Receiving tank samples will be tested as follows:

1. Color.
2. Appearance.
3. FSII (all turbine fuels only).
4. Flash point (JP-5, F-24 and JP-8 only).
5. API gravity.
6. Sediment/particulates by CCFD or gravimetric method.
7. Free water by DFWD.

9.2.1.3 Fuel Received by Barge or Tanker at Shore Stations

Before discharge from the vessel is commenced, an all-levels sample will be taken from each tank and tested as follows:

1. Color.
2. Appearance.
3. FSII (all turbine fuels only).
4. Flash point (JP-5, F-24 and JP-8 only).
5. API gravity.
6. Sediment/particulates by CCFD or gravimetric method.
7. Free water by DFWD.

9.2.2 Fuel in Storage Tanks at Shore Stations

Fuel tanks must be kept as clean and dry as possible. Inactive tanks shall be gauged once a week with water-finding paste. When water is found it shall be drained as soon as possible.

Once each month, a bottom sample shall be taken from each tank to determine the presence of undetected water and to measure bottom sediment/particulate levels.

Fuel stored for long periods of time shall be sampled and fully tested in accordance with the applicable specification each 6 months for turbine fuels and each 6 months for aviation gasoline. Should any fuel approach the deterioration use limits ([Appendix B](#)) within these time periods, testing frequency shall be increased to assure that fuel quality is maintained. Such fuel shall also be rotated and consumed as soon as possible.





9.2.3 Fuel Issued to Aircraft

Fuel in refueler trucks, direct fueling stations, or other shore-based equipment used to dispense fuel directly into aircraft shall be recirculated (flushed) through the equipment/system's hose and refueling nozzle and back to a fuel tank prior to the first refueling of the day. During recirculation the fuel shall be sampled at the nozzle and tested for:

1. Color (visual inspection).
2. Appearance (visual inspection).
3. Free water (CCFD/FWD or equivalent).
4. Sediment/particulates (CCFD or equivalent).

Note

- A minimum of two samples are required when running both a sediment/particulate and free water test (one for each test). Fuel that has been tested for sediment/particulates, free water, or FSII shall not be reused to run any other test since this practice could lead to inaccurate results.
- If a refueling facility's risk assessment conducted in accordance with OPNAVINST 3500.39 indicates that there is a low probability of sediment/particulate and water contamination entering the fuel distribution system, then the responsible TYCOM may authorize the substitution of a visual inspection in place of the requirements of [steps 3](#) and [4](#) above. If visual inspections for free water and sediment/particulates are authorized, then at least once every 7 days activities shall test samples from each in service refueling system for free water and sediment/particulates using the CCFD. If the activity has a CFD instead of a CCFD, then the sample shall be tested for free water using the FWD.
- If a refueling facility has an operating receipt filter (filter-coalescer or micronic) prior to its bulk storage tanks and an operating two-stage filter/separator vessel prior to its day (service) tanks and a two-stage filter/separator vessel at the truck fill stand or prior to a direct refueling station, then a facility risk assessment is not required and a visual inspection may be substituted for the requirements of [steps 3](#) and [4](#) above. When visual inspections are substituted for the requirements of [steps 3](#) and [4](#), then at least once every 7 days samples from each in service refueling system shall be tested for sediment/particulates and free water using the CCFD (or equivalent).

Recirculation (flushing) and testing are required on all in-service refueling equipment/systems once during every 24-hour period.

Note

Naval Air Stations designated as en route facilities that are equipped with Type III hydrant systems using either hydrant servicing vehicles or detachable pantographs will conduct a monthly high flow flush of the Type III system in accordance with USAF T.O. 37-1-1 Chapter 4. In place of the testing required by USAF T.O. 42B-1-1 Table 4-1 section 6b, sediment/particulates (CCFD) and free water (CCFD) will be performed.

Shore activities shall, at a minimum, conduct monthly spot checks of FSII levels in each storage tank and each piece of mobile refueling equipment. Testing shall be conducted using the B/2 Anti-Icing Test Kit.





9.2.4 Routine Correlation Sampling and Testing

Each activity shall take a series of routine, duplicate correlation samples to verify in-house testing procedures and equipment are working properly. The results from this sampling/testing program are used by the TYCOMs and SYSCOMs to monitor the general quality of fuel loaded into aircraft.

The exact number of routine duplicate correlation samples drawn, shipped and tested each month by each shore station depends upon the number of CCFDs and B/2 Anti-Icing Refractometers the activity possesses. As an absolute minimum, each activity shall draw one set of duplicate samples (two 1-quart bottles) for each CCFD and one set (two 1-quart bottles) for each B/2 anti-icing refractometer. Take and process each duplicate set of samples as follows:

1. Randomly select a direct refueling system, refueler truck, and etc.
2. Extract two 1-quart samples, one immediately after the other, from the refueling nozzle of the system while it is being recirculated or flushed.
3. Take both samples back to the activity's laboratory.

Note

If more than one set of duplicate samples are being taken at one time, appropriate steps must be taken to assure the source of each set of samples can be positively identified.

4. Test one of the samples using either the CCFD or B/2, as appropriate, and record the results in a log (see [Figures A-2 and A-3](#)).
5. Complete a fuel sample label (see [Figure A-4](#)) and attach it to the second (duplicate) sample. The results obtained using the CCFD or B/2 shall be entered on this label.
6. Ship the labeled, second (duplicate) sample to a regional fuel testing laboratory (see Appendix B of MIL-HDBK-844B(AS) for a list of laboratories) for testing of the sediment/particulates (using the ASTM D 2276 gravimetric method) or FSII as indicated on the sample's label.
7. When results from the regional laboratory are received, enter them into the appropriate log next to the result obtained using the activity's CCFD or B/2 Test Kit. Compare the two results on the duplicate samples to verify the accuracy of the CCFD or B/2 Test Kit.

Aircraft refueling activities (NASs, NAVAVNDEPOTs, etc.) that routinely perform the gravimetric test method for sediment/particulates (ASTM D 2276 or ASTM D 5452), rather than the CCFD, are not required to send correlation samples to a regional laboratory; however, such activities are not exempt from the reporting requirements of [paragraph 9.7.3](#). As a minimum, they shall forward a quarterly report showing at least four sediment/particulate and two FSII test results on random fuel samples extracted from aircraft refueling nozzles.

9.3 SAMPLING PROCEDURES

Proper sampling of petroleum products is as important to quality surveillance as proper testing. Improper containers and poorly-drawn or mishandled samples can cause laboratory results to be meaningless, or worse, misleading.

Directions for sampling cannot be made explicit enough to cover all cases. Judgment, skill, and experience should supplement any group of instructions. Consequently, the person assigned to take samples shall be trained, experienced, competent, and conscientious. The responsibility for taking and preparing samples shall not be lightly delegated.

This section provides general information on petroleum sampling techniques and practices. For more detailed information and instructions, including descriptions of the various types of samples (e.g., all-levels, bottom, composite, etc.), consult ASTM Standard Practice D-4057, which is available from the Standardization Documents Order Desk.





9.3.1 General Rules

1. The sampler's hands shall be clean.
2. Sample containers, clear glass quart bottles or LDPE/HDPE plastic bottles, shall be meticulously cleaned (washed with laboratory glassware detergent [Alconox (NSN 7930-01-107-9169), Liquinox (NSN 7930-00-279-7089), Alcojet (NSN 7930-01-326-8099) or Fisherbrand Sparkleen] and water, rinsed with clean water, and oven- or air-dried). Wipe bottles clean with lint-free cloths (i.e., MIL-C-85043 Type II).

Note

Alcohol shall not be used to clean sample bottles.

3. Samples shall be representative of the product being sampled. Samples shall be taken with the system operating at normal flow rates and steady state. Samples drawn during static (no flow) conditions are not representative of the full fuel flow and will give false results.
4. Samples shall be capped promptly, protected from light, and handled expeditiously.
5. Samples taken for shipment to shore laboratories shall be taken only in 1-quart glass sample bottles. Glass sample bottles for shipment to shore laboratories shall be filled to 1 inch below the cap.
6. LDPE/HDPE plastic bottles are authorized for use for the collection of sediment/particulate and free water fuel samples.
7. LDPE/HDPE plastic bottles shall be marked for the appropriate level (800 mL or 500 mL) and filled only to this mark.
8. Samples taken to test filter/separator efficiency shall be taken at the filter discharge.
9. Visual samples shall be taken in clear glass bottles only.

9.3.2 Sample Containers

The following fuel sampling bottles, containers, kits and safety cans are available through the supply system and are the only type authorized for the collection, retention, and submission of aviation fuel samples.

1. Kit, Fuel Sampling. A complete kit consisting of metal shipping container, cushioning material (inner-pack), and four 1-quart sample bottles, NSN 8115-00-719-4111.
2. Cushioning Material. Replacement top/bottom packing material for the above fuel sampling kit, NSN 8115-00-719-4825.
3. Replacement Kit. Replacement bottles and tags for the above fuel sampling kit, NSN 8115-00-717-8572.
4. Container, Fuel Sample. A 1-gallon, 24-gauge steel, epoxy resin lined fuel sample can suitable for the shipment or retention of fuel samples, NSN 8110-00-128-6819.
5. Drum, Shipping and Storage. A 5-gallon, 24-gauge steel, epoxy-lined fuel sample container suitable for shipment or retention of fuel samples, NSN 8110-00-400-5748.
6. Bottles, Glass, Clear. Twelve 1-quart clear glass bottles (without tags) suitable for taking visual samples and for shipping fuel samples to shore laboratories, NSN 8125-00-378-9994.
7. Bottles, LDPE/HDPE Plastic. Plastic bottles suitable for taking sediment/particulate and free water samples are available in two sizes:
 - a. 1000 mL, NSN 6640-01-300-3541 (6 bottles).
 - b. 500 mL, NSN 6640-01-461-1016 (12 bottles).
8. Container, Safety Can. Containers for the safe storage and transport of used fuel are available in two sizes:
 - a. 1 gallon, NSN 7240-00-177-4999.
 - b. 5 gallon, NSN 7240-00-178-8286.





9.3.3 Identification of Sample

All samples sent to a fuel testing laboratory shall be individually tagged with a label (see [Figure A-4](#)) containing the following minimum information:

1. The originating activity's name and address. A point of contact and phone number should be included.
2. Sample serial number (sampling activity's designation assigned to this particular sample) UIC-Julian date-sequential number.
3. End destination point of contact and phone number should be included.
4. Type fuel.
5. Date sample was taken.
6. Approximate time the sample was taken.
7. The source of the sampling point (nozzle sample, refueler number, or tank number).
8. Name of the person who drew the sample.
9. Classification of sample and tests required (See [paragraph 9.2.4](#)).
 - a. ROUTINE Correlation (insert CCFD or B/2 results in space provided).
 - or
 - b. SPECIAL (list tests required and/or pertinent remarks. This is especially important when sending in special samples. The comments will assist laboratory personnel in determining what additional tests should be performed).
10. Identify in the remarks section where the regional laboratory reports are to be distributed. See [paragraph 9.7.5](#). Distribution lists for reports are found in [paragraph 9.7.3](#).
11. Identify the type of sample taken: all level, line tap, bottom etc.

9.3.4 Sample Classification

All samples shipped to a fuel testing laboratory shall be classified either ROUTINE Correlation or SPECIAL.

9.3.4.1 Routine Correlation Sample

Routine Correlation samples are the samples taken when no fuel problems or aircraft problems attributable to fuel are known or suspected (see [paragraph 9.2.4](#)). These samples and their test results serve two purposes:

1. They assist the activity in monitoring and 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 (CCFDs and B/2s).

As a minimum, these routine correlation samples are sent once a month; however, this does not preclude sending correlation samples more frequently if concerns arise about the results being obtained with local equipment.

9.3.4.2 Special Sample

Special samples are submitted for testing because the quality of the fuel is suspect either as the result of aircraft malfunctions or for other reasons. Special samples have the highest priority in handling, testing, and reporting.

9.3.5 Shipping Instructions

Samples are to be forwarded to appropriate testing laboratories by the most expeditious means. A listing of military petroleum laboratories is included in MIL-HDBK-844B(AS).

Wherever feasible, samples shall be delivered directly to the laboratory by special courier.





Samples to be shipped by military aircraft shall be packed in accordance with the requirements of the manual on Packaging and Handling of Dangerous Materials for Transportation by Military Aircraft (AFM 71-4/TM 38-250/NAVWEPS 15-03-500/MCO P4030.19). The sampling kit listed in [paragraph 9.3.2](#) above meets these requirements.

WARNING

New sample bottle caps shall be used for all samples in this sample kit.

9.4 FUEL LABORATORY, TEST EQUIPMENT, AND METHODS

9.4.1 Laboratory

Each activity that refuels aircraft shall have a designated laboratory where in-house inspections and tests can be performed in a clean, safe environment. [Paragraph 11.11.5](#) contains the minimum requirements for a fuel laboratory.

Laboratories with a broader mission and more extensive testing capability will be configured to handle the quantities and types of materials that can be expected to be encountered in such an operation.

9.4.2 Testing Equipment

The following test equipment is authorized for the in-house testing of fuel samples:

1. Combined Contaminated Fuel Detector (CCFD). This instrument is used to analyze the sediment/particulate contamination in a sample of fuel. Currently, the only CFD being procured is the CCFD, NSN 6640-01-013-5279, which includes an obsolete built-in FWD Viewer Kit. The regular CFD, NSN 6630-00-706-2302, is still available and may be used. The DFWD from item 3 is available as a standalone device to be used for free water testing. Future CCFD models with a built-in DFWD may be available. Additional materials needed to conduct tests:

WARNING

The Combined Contaminated Fuel Detector (CCFD) electrical components are not rated for use with AVGAS and cannot be used for this application due to explosive hazard.

Note

If inoperable replace immediately.

- a. Filter Element, Fluid, 0.65 micron — NSN 6640-00-967-0500.
- b. Filter, Wratten — NSN 6630-00-849-5288.

Note

Shore Activities may use the gravimetric procedure specified in ASTM D 2276 as an alternate method of measuring sediment/particulate contamination. Consult the ASTM test method for details on the equipment and materials needed to perform this test.

2. Digital Free Water Detector (DWFD), ASTM D3240 (NSN 6640-01-642-9285). This instrument is used to determine the free-water content of aviation fuels. Additional materials needed to conduct tests:
 - a. Detector Pad, Free Water (25 mm), 50 count, NSN 6640-00-235-3820.
 - b. Detector Pad Holder (25 mm), NSN 6665-01-642-9295.





3. Manufacturer calibration of NSN 6640-01-642-9285 shall be required by either the following:
 - a. The reported value is outside of the shuttle calibration standard range.
 - b. Within twelve months of manufacturers expiration date supplied with each unit.
4. The following devices are used to determine the FSII content of aviation fuels.
 - a. B/2 Anti-Icing Test Kit or Fuel System Icing Inhibitor (FSII) Refractometer, NSN 6630-01-165-7133.
 - b. Gammon HB/2D Digital Refractometer, NSN 6650-01-633-0096.
 - c. MISCO PA202 Digital Refractometer, NSN 6650-01-615-4842.
5. API Thermo-Hydrometers and a 1,000-mL clear, plastic, or glass graduated cylinder. These should be used to determine the specific API gravity of the fuel.
 - a. Thermo-Hydrometer, graduate 29- to 41-degree range, JP-5/8, non-mercury filled, NSN 6630-00-242-9258.
 - b. Thermo-Hydrometer, graduate 39- to 51-degree range, JP-5/8, non-mercury filled, NSN 6630-00-245-8376.
 - c. Thermo-Hydrometer, graduate 49- to 61-degree range, JP-4 and MOGAS, NSN 6630-00-245-8377.
 - d. Thermo-Hydrometer, graduate 59- to 71-degree range, JP-4, MOGAS, and AVGAS, NSN 6630-00-245-8374.
 - e. Thermo-Hydrometer, graduate 69- to 81-degree range, AVGAS, NSN 6630-00-245-8375.
 - f. Anton Parr DMA 35 digital density meter, NSN 6635-01-576-2591.
6. Flash Point Test Equipment. This equipment is used to determine the flash point of a fuel sample. It is absolutely essential that all activities possess one of the following instruments, since any fuel removed from an aircraft and destined for storage must have its flash point tested in order to determine its disposition.
 - a. Pensky-Martens closed cup flash point tester, NSN 6630-00-530-0987. (This equipment requires use of a propane cylinder.)
 - b. Electronic flash point tester (NAVI-FLASH), NSN 6625-01-472-6783. (Requires N-Dodecane for calibration.)
 - c. N-Dodecane Calibration Standard, NSN 6810-01-419-2677 (for use with electronic flashpoint tester).

9.4.3 Test Methods

Instructions for performing the appearance or visual test, the backbone of any fuel quality surveillance program, are contained in [paragraph 9.5.1](#). General instructions and procedures for conducting tests with the equipment listed in [paragraph 9.4.2](#) are contained in MIL-HDBK-844B(AS). Specific, detailed instructions, however, are contained in the operating manuals provided with each test instrument at the time of procurement. Replacement copies of these manuals maybe obtained from NAVAIR AIR-4.4.5.

9.5 INTERPRETATION OF TEST RESULTS

To be acceptable for delivery to aircraft, aviation fuel must be clear and bright and contain no visually detectable free water.



**WARNING**

Personnel fueling aircraft shall cease fueling operations immediately upon detecting any departure from acceptable criteria and inform the pilot, maintenance officer, or other designated person in charge as to the condition of the fuel delivered. Failure to identify and stop refueling operation can lead to loss of aircraft, pilot, and crew.

When off-specification fuel is identified, the refueling truck or other source of fuel will be placed out-of-service pending investigation and any corrective action that may result. The pilot, maintenance officer or other person in charge, when notified that doubtful or contaminated fuel has been delivered to an aircraft, will take action to determine whether the aircraft should be defueled and cleaned.

9.5.1 Appearance (Visual Test)

The test shall be conducted using a round, transparent, glass bottle, 1 quart to 1 gallon in size. The bottle shall be clean. The sample is first visually inspected for color and presence of foreign matter. The sample shall then be swirled to form a vortex. Particles coarse enough to settle will collect as sediment/particulates on the bottom of the bottle directly beneath the vortex.

A passing sample shall be “clear and bright,” which means free of any cloud, emulsion, or readily visible sediment/particulate matter. The color should be clear and colorless to straw-yellow. When any appreciable contamination is found, the test shall be repeated, paying particular attention to cleaning and rinsing the container prior to sampling. Also, if there is any question about the quality of the fuel, both sediment/particulate and water measurements must be made using the CCFD and the FWD.

9.5.2 Sediment/Particulates

Solid contaminants (rust and dirt) can be held well below a level of 1 mg/L in a properly functioning fuel distribution system. If solid contaminants in fuel at aircraft dispensing points exceed 1 mg/L, investigative and corrective action should be taken to improve fuel quality.

WARNING

If solid contaminants exceed 2 mg/L, delivery of fuel to aircraft shall be stopped and corrective measures completed prior to resumption of fueling operations. Loading aircraft with fuel with excessive contamination can result in a malfunction of the airframe or engine fuel system and subsequent loss of aircraft, pilot and crew.

9.5.3 Free Water

A satisfactorily performing filter/separator will provide fuel containing less than 10 ppm of free water. Should the level of free water in fuel at an aircraft dispensing point exceed 10 ppm, a second sample will be taken immediately to ascertain if the second sample confirms that the free water exceeds 10 ppm. If so, fueling shall be stopped until changes in procedure and equipment that reduce the free water to 10 ppm or below are effected.





During the receipt of fuel into a storage tank, if the other tests are satisfactory but the sediment/particulate and/or free-water contamination is high (above 2 mg/L of sediment/particulate contamination or 10 ppm of free water), extra testing and surveillance shall be conducted downstream to assure that this contamination is reduced by settling and filtration to acceptable levels before dispensing to aircraft.

9.5.4 FSII

FSII performs two important functions that help to avert significant safety-of-flight problems. First, it prevents the formation of water-ice in aircraft fuel systems, which can occur in certain susceptible aircraft. Second, FSII acts as a biostat preventing the growth of various microorganisms that can contaminate fuel systems (air station as well as aircraft), block filters, and promote corrosion.

The minimum level of FSII in fuel for USN/USMC aircraft requiring FSII to prevent water-ice formation is 0.03 percent. The minimum level of FSII in aviation turbine fuel for other US services' is 0.04 percent. The minimum level of FSII in aviation turbine fuel for foreign aircraft is 0.07 percent.

Shore stations have no means of raising the FSII level of their JP-5 (or other turbine fuel). FSII materials are mutagenic and considered to be dangerous in the neat state; however, they are safe once blended into the fuel. Station injection of FSII is not recommended. Refer to MIL-HDBK-844B(AS) for guidance on raising FSII level by commingling fuel between tanks.

If the FSII level falls below the 0.03 percent limit, the fuels maintenance officer shall notify the appropriate Navy or Marine Corps squadron Commanding Officer (CO) or his/her designated representative, via the air officer. The applicable NATOPS Aircraft Flight Manual shall be consulted by the pilots for operating instructions, which will avoid resultant safety-of-flight problems.

Transient (USAF, USA, and visiting foreign military aircraft) crewmembers and pilots will be notified of low FSII (levels of 0.07 percent or less) in order that they may consult their appropriate technical directives for special operating instructions necessary to avoid water-ice induced problems.

WARNING

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

Note

The B/2 Anti-Icing Test Kit Refractometer contains two FSII scales, one for each of the two different FSII materials currently in use. All JP-5 fuel tested shall be assumed to contain the high flash point type of FSII material, Diethylene Glycol Monomethyl Ether, or DiEGME, which is read off of the scale on the B/2 refractometer marked "JP-5" or "M." Newer models of the B/2 refractometer may be only marked "DiEGME."

9.5.5 Other Test Results

The results of all other tests shall be evaluated by comparison with the limits described in [Appendix B](#), which contain the Deterioration Use Limits for Aviation Fuels. The limits in these two figures refer specifically to the acceptability of aircraft fuels for delivery to aircraft. The particular facility or ship from which the fuel is being removed and the one into which it is being loaded must be considered when applying these use limits; a limit on free water of 10 ppm maximum or 2 mg/L on sediment/particulates may not be applicable to a sample from a large shipment if subsequent cleanup in the fuel handling system can be anticipated.





Any activity that suspects either chemical contamination, deterioration during storage, or other unusual contamination or condition shall send fuel samples to an appropriate regional fuel laboratory (see Appendix B of MIL-HDBK-844B(AS)) for testing. Samples must be clearly labeled as discussed in [paragraph 9.3.3](#) with information about the suspected problem included in the remarks section.

WARNING

Failure to identify contaminated fuel and removal from use can result in reduced aircraft engine performance, malfunction, or catastrophic failure.

Inquiries pertaining to the quality or testing of aviation fuels and lubricants shall be addressed to COMNAVAIRSYSCOM (AIR-4.4.5), with a copy to the NAVSUP Energy Office.

9.5.6 Routine Correlation Samples

Compare test results obtained by the activity's in-house laboratory with those obtained by a regional fuel laboratory on the duplicate sample (see [paragraphs 9.2.4](#) and [9.3.4.1](#)). Some variation between the two test results is possible because of errors introduced by the shipment and storage of the duplicate fuel sample as well as differences in the test techniques. No action is necessary unless differences between the two results are greater than 0.8 mg/L. If this happens, recalibrate the CCFD following the instructions provided with the machine, review the testing procedure, and submit and test more duplicate correlation samples. If results are still unacceptable, contact NAVAIR AIR-4.4.5 for further guidance.

The results of the FSII correlation sample tests should also be compared. Variation by as much as 0.03 percentage points is considered acceptable. If greater differences are noted, review the procedure, recalibrate the instrument, and take additional correlation samples and test them. If results are still out of the acceptable range, contact NAVAIR AIR-4.4.5. It may be necessary to procure a new refractometer.

9.5.7 Aircraft Low Point Drain Samples

COMNAVAIRFORINST 4790 requires that fuel samples be taken periodically from the low points of aircraft fuel tanks in order to remove water and dirt, and verify the quality. The specific requirements for this aircraft maintenance action are contained in the individual aircraft model maintenance manuals. Fluid should be drained from each specified low point, in accordance with COMNAVAIRFORINST 4790, and visually inspected to determine if it is clear and bright fuel without visible sediment or water. The same criteria for fuel quality used in [paragraphs 3.5](#), [9.5](#), and [15.5](#) should be used for aircraft fuel tank low point drain samples.

9.6 GUIDELINES FOR REQUESTING REGIONAL LABORATORY SERVICES

1. Samples shall be forwarded to a Navy laboratory if practicable. See Appendix B of MIL-HDBK-844B(AS) for a list of laboratories.
2. Decisions about which laboratory to use shall be based upon laboratory proximity, capabilities, and workload if known.

Note

Not all laboratories are available for regular recurrent testing on a no-cost basis.

9.7 REGIONAL LABORATORY TEST METHODS AND REPORTING

The following paragraphs provide instructions to regional laboratories that receive fuel samples from a shore activity.

9.7.1 Routine Samples

Laboratories receiving samples for routine fuel quality checks shall test the samples as requested on the sample label for one of the following properties using the listed ASTM method:





1. Sediment/Particulates, ASTM D 2276.
2. FSII content, ASTM D 5006.
3. Flash point, ASTM D 93 or D 6450.

Laboratories shall also note the presence of significant amounts of free water in the bottom of the sample container. Laboratories shall not run free-water determinations on routine samples since the free-water content of the fuel is severely affected by normal shipping and handling of the sample and results are meaningless.

Note

All JP-5 fuel tested shall be assumed to contain DiEGME.

9.7.2 Special Samples

Laboratories receiving special samples for testing shall conduct requested tests in accordance with methods authorized by the applicable fuel specification.

9.7.3 Reporting

Laboratories performing these tests shall report the results to the following:

1. Original — Commanding Officer of ship or station submitting sample.
2. One copy each — (All aviation fuel test reports).
 - a. Commander
Naval Air Systems Command (AIR-4.4.5) 22229 Elmer Rd., Unit 4
NAS Patuxent River
Patuxent River, MD 20670
 - b. Commander
Naval Air Forces U.S. Atlantic Fleet
(Code N415 for ashore samples)
Norfolk, VA 923511-5188

or

- c. Commander
Naval Air Forces U.S. Pacific Fleet
(Code 44 for ashore samples)
Naval Air Station, North Island
San Diego, CA 92135-5100
- c. Commanding Officer
NAVSUP Energy Office
8725 John J. Kingman Road
Suite 3719
Fort Belvoir, VA 22060-6224

9.7.4 Report Forms

Regional laboratories are requested to report results in a form similar to [Figure A-5](#) in [Appendix A](#). It is essential that the CCFD and B/2 results reported by the sampling activity on the sample's label be included along with the results obtained by the regional laboratory.

9.7.5 Distribution Lists for Reports

It is the responsibility of the activity submitting samples to a laboratory to provide the laboratory with the desired distribution of reports in accordance with [paragraph 9.7.4](#).





9.7.6 Message Reports

When a “special” fuel sample has been tested and the results exceed the deterioration use limits of [Appendix B](#), the testing laboratory will report the finding as soon as possible by telephone to the aviation activity that submitted the sample. The telephone report shall be followed by a message report. During nonworking hours, the aviation activity's duty officer shall be notified of the test results. It is unnecessary to report test results via telephone or message for “routine monthly correlation samples that exceed the use limits for sediment/particulates; however, if the FSII content is found below the 0.03 limit, a telephone and message report is required.

9.8 PROCEDURES FOR PREVENTING AND CONTROLLING CONTAMINATION

Contamination of aviation fuel can be prevented only by the use of proper equipment and by carefully following proper operating procedures. Aviation fuel handling systems shall be used by all aircraft refueling activities to contain and process the fuel immediately prior to issue to aircraft. At shore stations these systems include an approximate 10-day supply (based on normal base issues to aircraft) storage capacity. Shore-based storage tanks used in this system must have sloping bottoms, bottom suction (pick-up), and continuous recirculation through a filter/separator that removes both water and sediment/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.

The proper care, operation, and maintenance of these systems are essential in assuring that only clean, dry fuel enters aircraft. As a minimum, operators shall:

1. Observe and record the pressure drops at least daily across all filter/separators in order to detect failures or problems.

Note

Pressure drop readings depend on the flow rate of the fuel through the filter. Meaningful readings can be obtained only if the system is operating at normal flow conditions during recirculation or flushing.

2. Take every precaution possible to prevent the introduction of any sediment/particulate matter (dirt) into the fuel. (See discussion in MIL-HDBK-844B(AS).)
3. Install and maintain dust-tight caps or covers on all openings and connections, including refueling nozzles. These caps shall be removed only when item or system is in use.



Dust caps on Gammon fittings shall not be used on the flightline since they present a FOD hazard.

4. Brush away or remove any accumulated dirt or sand around fill covers, manholes, and other covered openings before removing cover.
5. Never leave a storage tank, refueler tank, or other vessel open to the air any longer than absolutely necessary.
6. Semipermanently secure refueler manhole covers.

Note

Recirculation of product and taking a sample through tank top openings is not authorized.

7. Do not operate any fuel handling equipment unless all filters, strainers, screens, and nozzle spout caps are properly installed and in place.
8. Never remove any filter, strainer, or screen for any purpose, except for cleaning or maintenance. Always replace filter or screen immediately after cleaning.





9. Observe and report any unusual operating condition, for example, if the refueling nozzle screen requires an unusual amount of cleaning.
10. Observe water that is drained from refueler and filter/separator sumps. It should appear clean. Report any unusual accumulation of foreign matter.
11. Drain (strip) and check all refuelers, tanks, filter/separators, and equipment provided with manual drains daily.
12. Circulate stagnant product in refueling equipment to remove condensate and sediment/particulate contaminants from lines, hoses and nozzles prior to aircraft issues. This is mandatory for any refueling equipment that has not been in use for a period of time exceeding 24 hours. Minimum circulation time must be determined locally for each piece of equipment depending on its configuration and size as well as fuel flow rate. Allow sufficient time for the fuel in the piping and hose(s) downstream of the fuel filter/separator to be completely replaced by clean, dry fuel.
13. Ensure regularly scheduled maintenance is properly performed.
14. Keep refueler tanks filled when not in use or when no defueling is anticipated.
15. Dedicate truck mounted or trailer mounted refuelers to one type of fuel: JP-5, JP-4, AVGAS, etc. Never use the same refueler with a different fuel until all equipment has been properly flushed.
16. Mark all refuelers in accordance with Naval Facilities Engineering Command Publication NAVFAC P-300, Management of Transportation Equipment. Storage facilities and distribution systems shall be marked in accordance with MIL-STD-161.
17. Check fuel product markings on each separate piece of equipment for agreement before initiating any fuel transfer operation.
18. Never load or carry two different aviation fuels in one refueler.
19. Use separate pipelines and equipment for each product.
20. Report and investigate any suspected contamination or irregularity detected. The FMO shall be responsible for initiating the investigation and formulating corrective actions.
21. Report and correct any leaking valves, lines, or connections.
22. Never use equipment configured solely as a defueler for refueling aircraft.
23. Cure hoses before using.

Note

API 1529/NFPA 407 hoses do not need to be cured.





CHAPTER 10

Safety in Shore Activity Fuel Handling Operations

10.1 INTRODUCTION

This chapter contains safety procedures and requirements that are either general in nature and therefore not covered by the other chapters of this manual or are extremely important and repeated here for emphasis. Any departure from the procedures of this chapter may adversely effect the overall safety of the operation being performed.

Although the procedures and requirements contained in this manual are as complete as possible, they are no substitute for a thorough knowledge of aviation fuels and their inherent characteristics and dangers. All aviation fuels personnel shall therefore be completely familiar with the information contained in MIL-HDBK-844B(AS). As refueling personnel master a knowledge of aviation refueling, they will be better able to avoid and correct unsafe situations.

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 is the investigation of field accidents or problems. Therefore, it is extremely important that knowledgeable personnel be involved in accident investigations, especially whenever explosions or fires have occurred. Activities shall therefore request the assistance and participation of experts whenever major fuels accidents are being investigated to ensure correct conclusions are drawn. NAVAIR, NAVSUP Energy Office, and TYCOMs will assist in the identification of appropriate experts for any specific investigation.

10.2 ELIMINATING SOURCES OF IGNITION

10.2.1 Reducing Electrostatic Charges

WARNING

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

One of the primary sources of ignition is static electricity. To ensure the safe relaxation of static charges relevant to fuel operations, all activities shall:

1. Prohibit the top loading or splash filling of any fuel vessel (e.g., trucks or tanks).
2. Refill filter/separator vessels slowly, whenever they have been drained.
3. Keep tanks free of foreign objects (i.e., small conductive objects that can be floated by foaming fuel, thereby becoming an unbonded charge collector).
4. Always electrically bond the refueling equipment to the aircraft or truck into which the fuel is being loaded.
5. Grounding is required for all hot refueling operations.
6. Check the electrical resistance of single point nozzle monthly. (See the nozzle manufacturer's technical manual for instructions.)





7. Bond overwing (gravity) refueling nozzles to the aircraft using a separate bonding pigtail before tanks caps are removed.
8. Inspect bonding and grounding cables, clamps, and plugs on a daily basis.
9. Check the electrical resistance of grounding cables on a monthly basis.
10. Cease all fueling activities when lightning is observed within 5 miles of the facility.
11. Remove refuelers from aircraft parking areas during electrical storms.
12. Require fuel personnel to wear nonstatic producing and flame retardant clothing.

Note

Gortex outer garments are authorized for wear by refueling personnel.

10.2.2 Eliminating Other Sources of Ignition

To prevent or eliminate sources of ignition, activities shall:

1. Prohibit fuel personnel from wearing shoes with nails or other metal devices on the soles.
2. Advise fuel personnel not to carry or wear loose metal objects, such as knives or keys.
3. Check the exhaust piping on mobile refuelers daily to ensure holes, cracks, or breaks do not exist.
4. Prohibit smoking, spark or flame producing items, open flames, or hotwork within 50 feet of any refueling operation.
5. Defer all repair work on fueling equipment during fuel handling operations.
6. Not introduce lights (except approved safety lights for use in hazardous locations) into any compartment or space where fuel or flammable vapors may be present. (API has determined that ordinary commercial two-and three-cell flashlights, using carbon zinc dry cell batteries, may be safely used around flammable fuel/air mixtures. Tests have proven them incapable of igniting vapors, even if accidentally dropped or the light bulb is crushed.)

WARNING

Always assume that fuel vapors (in a tank or above a pool of fuel) are in the flammable range (i.e., proper fuel-air mixture to ignite).

7. Not allow fuel personnel to carry matches or cigarette lighters.
8. Be certain that no repair or maintenance work is being conducted on the aircraft during the refueling or defueling operation.

Note

Fixed wing aircrew may perform normal preflight/postflight duties (visual inspection and removal/installation of covers).

9. Be certain that LOX operations are not being performed and LOX handling equipment is not located within 50 feet of fuel operation.
10. Be certain that aircraft radar and all unnecessary radio equipment is switched off before refueling or defueling commences. If it is necessary that equipment be warmed up prior to an immediate launch, be sure that it is not transmitting. The only exception to this rule occurs during hot refueling. Hot refueling operations require the pilot to keep in radio contact with the tower at all times.
11. Not conduct aircraft fuel handling operations within 300 feet of ground radar equipment.





12. Equip all internal combustion engines operated within 50 feet of fuel handling operations with spark-arresting type mufflers.
13. Avoid starting or stopping any engine, regardless of its configuration, within 50 feet of a fueling or defueling operation. This prohibition includes aircraft being serviced and adjacent aircraft, as well as ground support equipment. The starting or stopping of an engine within 50 feet of a fueling or defueling operation is sufficient cause for the operator to immediately shut down the fuel pump.
14. Open valves slowly to avoid or minimize any splashing in tanks.
15. Ensure pump suction is flooded before starting in order to avoid introducing air into the fuel system. Air in the fuel system can produce fire/explosion in Filter/Separators (F/Ss) and cause pump damage. Truck and rail car off-load systems are especially prone to this problem.
16. Conduct overwing refueling only as a last resort and then only if operational necessity or aircraft design dictates.
17. Hold hot refueling operations to the absolute minimum possible. Cold refueling operations are inherently safer and are preferred to hot refueling.

10.3 REDUCING OR CONTROLLING VAPOR GENERATION

In order to help prevent fires by reducing or controlling vapor generation, activities shall:

1. Not handle aviation fuel in open containers.
2. Not refuel, defuel, or drain aircraft, or conduct fuel handling operations in a hangar or confined area, except for the removal of water and the extraction of samples from aircraft low point drains. This does not apply to structures specifically designed for these operations.
3. Keep all fuel containers, such as aircraft fuel tanks or vessels, closed except when necessary to open for actual operation.
4. Avoid spilling fuel during fuel handling operations.
5. Take immediate action to clean up any spill that occurs.
6. Properly dispose of oily waste or rags immediately after using.
7. Never drive or move a refueler or defueler with a leak in the tank, piping, or other equipment.
8. Report all leaks in any portion of the fuel handling facilities to the FMO.
9. Treat empty, or apparently empty, cans or containers that formerly held aircraft fuels as though they still contain fuel. These containers will still contain vapors and are dangerous for many days after they have been emptied.
10. Be aware that fuel vapors are heavier than air and will collect in low places, such as pits, sumps, and open sewers.
11. Never dispose of waste fuel in storm water or sanitary sewage systems.
12. Never top load or splash fill tanks. (This does not prohibit overwing refueling of aircraft that are solely configured for this operation.)
13. Keep all equipment and work areas neat, clean, orderly, and in good mechanical condition.
14. Never use gasoline or jet engine fuel as a cleaning agent.

10.4 EXTINGUISHING FIRES

Although the Air Station's Crash Crew (Crash, Fire, and Rescue) has prime responsibility for firefighting, all fuel handling personnel should be aware of the basic principles involved in extinguishing fires as well as the equipment used. For maximum effectiveness and safety, fire extinguishers must be operated in accordance with the





specific procedures developed for each individual type. MIL-HDBK-844B(AS) contains a special section on fire extinguishment that has been extracted from NAVAIR 00-80R-14, U.S. Navy Firefighting and Rescue NATOPS Manual. All refueling personnel shall receive flightline fire extinguishing training initially and annually thereafter.

WARNING

Use all fire extinguishers only for their intended purpose (i.e., to extinguish a fire). They shall never be used to inert a fuel tank since this can actually ignite a fire or explosion.

10.5 MINIMIZING HEALTH HAZARDS

Aviation fuels must be handled with caution because of the obvious dangers associated with possible fires and/or explosions, and because these materials, themselves, present a danger to the health of fuel handling personnel. These dangers are equally important as those of fires and explosions even though they are not so well known. MIL-HDBK-844B(AS) contains a detailed discussion of the health hazards of aviation fuels.

In order to minimize health dangers, fuel handling personnel shall:

1. Avoid entering enclosed areas where fuel vapors are present.
2. Keep to an absolute minimum the amount of time spent breathing fuel vapors. Good ventilation of work spaces is essential.
3. Stay on the windward, or upwind, side of the spill when it is necessary to remain in an area where a large spill has occurred.
4. Stay on the windward, or upwind, side when conducting fuel handling operations where the formation of vapors is unavoidable, such as at a truck fill stand.
5. Stop the fuel handling operation and move to a fresh air location immediately if a feeling of dizziness or nausea occurs.
6. Avoid skin contact with liquid fuels and tank water bottoms that can contain a high concentration of FSII. If fuel or water bottoms do contact the skin, immediately wash with soap and water.
7. Never wash hands in gasoline or jet engine fuels.
8. Remove fuel-soaked clothing or shoes at once.
9. Wear eye protection and clothing that leaves a minimum amount of skin exposed during refueling operations. This will minimize burns in a fire.
10. Only use footwear that completely covers the feet in order to provide protection against fuel spills and fires. Shoes made of fabric or other absorbent materials are not acceptable.

10.6 CONFINED SPACES

Personnel entering or working in or around confined spaces exposed to fuels and fuel vapors may encounter potential hazards such as:

1. Lack of sufficient oxygen.
2. Presence of flammable or explosive vapors.
3. Presence of toxic vapors and materials.

These hazards may not always be readily apparent, detectable by odor, or visually obvious to persons entering or working within such spaces. Therefore, all confined or enclosed spaces such as fuel tanks, refueler/truck tanks, and unvented deep pits (over 5 feet) will be well-ventilated and tested prior to entry. Poorly vented or unvented pump





rooms, storage areas, and unvented shallow pits (under 5 feet) must be surveyed to determine steps necessary for gas freeing or designation of a safe work environment. To minimize risk, fuel handling personnel shall:

1. Never enter a tank or vessel that has contained any fuel until all safety precautions have been followed and then only with experienced, knowledgeable supervision present.
2. Use a blower-type mask or positive pressure hose mask, boots, and gloves if it is necessary to enter a confined area where fuel vapors may be present.
3. Employ the buddy system when entering deep unvented or poorly vented pits (i.e., low point drain pits).

More definitive information regarding the hazards of confined spaces, hazardous environments, and gas-free engineering is contained in NAVSEA S6470-AA-SAF-010, U.S. Navy Gas-Free Engineering Program Technical Manual and the NAVOSH Program Manual 5100.23B. All personnel shall comply with the Navy policies and procedures specified in these manuals.

10.7 WEAPONS HANDLING PROCEDURES

Airborne weapons handling evolutions introduce a degree of risk in carrier/shore base operations that require careful planning and preparation. The necessity to train for and to conduct operations requires the acceptance of certain risks that cannot be avoided in the handling of explosive weapons/practice weapons and fueling operations. Safety concerns shall continually be weighed, when performing each weapon/fueling evolution. The TYPE wing ordnance officers, station weapons officers, explosives safety officers, station fuels representative, air gunner/CVW ordnance officer, squadron ordnance officer and maintenance representative, shall ensure adequate supervision is maintained during all ordnance handling evolutions and fueling operations, whether handling inert or live weapons.

The squadron flight schedule and ordnance load plan, demands close coordination between the aircraft maintenance personnel, station ordnance personnel, squadron ordnance personnel and fuels personnel, to ensure all evolutions are conducted in a SAFE manner, to support all operations. (This encompasses required reconfigurations, performing aircraft release and control checks and loading.)

Simultaneous fueling, loading, and downloading of weapons to include preloaded IMERS/ITERS and "PASE" weapons and installation of fuses and arming wires is authorized with the following restrictions adhered to:

1. Loading/downloading and oxygen converter replacement can be done simultaneously, all other oxygen serving shall be conducted as separate evolutions.
2. Refueling hoses shall not be connected to an aircraft which is undergoing the Loading/Downloading of ordnance requiring electrical connections to the aircraft weapons system (i.e., installation/removal of umbilical cables, mating/unmating of the buffer connector/wafers and rocket motor firing contacts).
3. No electrical connections to weapons or installation of impulse cartridge(s) shall be accomplished while fueling of that aircraft is in progress.
4. Fuel hoses shall not be positioned under weapons being loaded/downloaded.
5. When lightning is observed within a 10-mile radius of the installation, all ordnance handling shall cease; ordnance should be made as safe as practical and personnel should seek cover. Aircraft already loaded not requiring arming procedures may taxi and launch at the discretion of unit commanding officers and pilots in command as modified by other applicable instructions. Aircraft already loaded with ordnance requiring arming shall not be armed during periods when lightning is observed within 10 miles. Aircraft landing during the above conditions requiring dearming shall remain in the dearming area until the lightning threat passes.

Once the aircraft have landed/taxied to their respective loading/refueling points, the following steps shall be performed:

1. Qualified ordnance personnel shall verify all ordnance is safe prior to commencing any refueling operations; Safe ordnance is defined as weapons safed in accordance with appropriate aircraft loading manuals, the





repositioning of any mechanical lever(s), and or any replacement of safety pin, electrical interrupt plug/pin, securing of armament switches, and/or appropriate action that renders the particular ordnance as safe.

2. Arming and dearming shall occur in designated ARMING/DEARMING AREAS and in succession from first to last landing point.

WARNING

As far as is practical, care shall be used to prevent personnel from passing in front of armed weapons (see [Figure 18-1](#) as an example).

3. In the event of a malfunction (e.g., jammed gun, hung live weapons) on an aircraft, the aircraft should be moved to a designated SAFING AREA for the gun/weapons system to be cleared or downloaded. An operational procedure, which includes fueling, may continue on all other aircraft.
4. All Hazards of Electromagnetic Radiation to Ordnance (HERO) and High Frequency (HF) procedures will be strictly adhered to in accordance with applicable NATOPS manuals.
5. FARP operations have unique requirements and procedures that may differ from other operational aircraft locations and those procedures must be strictly adhered to, in accordance with applicable NATOPS manuals.

WARNING

Due to simultaneous fueling and uploading procedures occurring on separate aircraft, all personnel shall maintain an awareness of the required distances during these phases.





CHAPTER 11

Shore Activity Facilities and Equipment

11.1 GENERAL REQUIREMENTS

This chapter establishes the minimum requirements for aviation fuel handling equipment and facilities at all Navy and Marine Corps activities that fuel aircraft. Departure from the minimum equipment/facilities requirements established in this manual may adversely affect aircraft safety of flight as well as the safety of fuel handling operations.

11.1.1 Filtration Requirements

All activities that refuel aircraft must process the fuel issued to aircraft through a minimum of two fuel filtration systems between operating storage and entering the aircraft. If aviation fuel can be pumped directly from a tank into an aircraft, aircraft direct fueling system or a refueler, treat the tank as an operating storage tank regardless of size and location. The tank must meet the applicable requirements for aviation turbine fuel operating tanks. Filtration equipment generates static electricity; therefore, all refueling systems must reduce static electrical charges to acceptable levels prior to loading on aircraft.

Note

Inbound filtration may be considered one of the two required fuel filtration systems.

11.1.2 Maximum Refueling Pressure

All aircraft pressure refueling systems must limit the maximum pressure at the aircraft's adapter to 55 psi measured at the sample port of the refueling nozzle. During the last few seconds of a refueling operation the aircraft's internal tank shut-off valves close, creating an instantaneous pressure surge within the aircraft's fuel system. The pressure control device on every refueling system must react quickly enough to limit this surge pressure to below 120 psi. All modern aircraft are designed, built, and tested for refueling within these pressure limitations.

Note

Highly specialized equipment is needed to measure a system's maximum surge pressure. Such testing must be conducted in accordance with SAE AS 1284A.

11.1.3 General Design and Repair Requirements

All fuel handling facilities and equipment at Navy and Marine Corps shore activities shall be designed, constructed, and/or repaired in accordance with Naval Facilities Engineering Command (NAVFACENGCOM) criteria, which have been established in collaboration with NAVAIR and the NAVSUP Energy Office. These manuals are kept up-to-date and contain many new concepts for incorporation in future military construction. All repair and modernization projects for POL facilities at Navy and Marine Corps air activities shall conform to the requirements stated in these manuals. In addition, all facilities shall comply with local environmental, health, and safety laws. NAVFAC, the NAVSUP Energy Office, and the TYCOMs can provide the FMO with help and guidance in developing repair and modernization projects.

Applicable publications are:

1. UNIFIED FACILITIES CRITERIA (UFC) 2-000-05N Facilities Planning For Navy and Marine Corps Shore Installations. Series 121 entitled, "Aviation Fuel Facilities."
2. UFC 3-460-01, Petroleum Fuel Facilities.
3. DoD Standard Design AW 79-24-29 (Aircraft Direct Fueling Systems).





4. Unified Facilities Guide Specifications (UFGS).
5. UFC 3-460-03 Operation and Maintenance: Maintenance of Petroleum Fuel Systems.

11.1.4 Refueling Equipment Markings and Painting

All fuel servicing equipment shall be painted and marked in accordance with NAVFAC P-300. All refueling equipment shall be clearly marked with the appropriate NATO Code Number contained in a rectangle as well as the common U.S. military designation. For example, JP-5 refueling trucks shall carry the following symbol as well as the JP-5 designation:



A complete list of the NATO Code Numbers can be found in Annex C of NATO STANAG 1135.

Refuelers used as refuelers/defuelers shall be marked with only the product code JP since the fuel will, in most cases, be a mixture of JP-4, JP-5, JP-8, F-24 and/or commercial jet fuels. No NATO Code Number is to be applied to such equipment.

In addition to these product identification markings, all refueling equipment shall be marked with the following:

FLAMMABLE
NO SMOKING WITHIN 50 FEET

The emergency shut-off switch for each system shall be identified with 2-inch red letters on white reflective background.

Refuelers/defuelers/ground fuel vehicles shall be free of rusted areas, flaking paint, and running rust. When touch-up painting exceeds 20 percent of the unit surface, the entire unit shall be painted.

11.1.5 Illumination

Unless otherwise directed, all working areas shall be illuminated for night operations to the minimum intensity recommended in Table 4 of API Bulletin RP-540, Recommended Practice for Electrical Installations in Petroleum Processing Plants.

11.1.6 Electrical Equipment

Electrical equipment installed on or in close proximity to fuel handling or storage facilities shall meet the minimum requirements of NFPA 70 (based on explosive risk of JP-4), The National Electric Code; NFPA 77, Recommended Practice on Static Electricity; and NFPA 78, Lightning Protection Code.

11.2 REFUELING EQUIPMENT

The following paragraphs provide a general description along with the minimum requirements for equipment common to all refueling systems including mobile equipment. These requirements apply to both new and existing equipment. In addition, for new construction and modernization projects, UFC 3-460-01 shall be consulted.



The design and construction of certain pieces of equipment listed in this chapter is especially critical to overall safety. For those items designated with a dagger (†), shore station fuel departments shall use only the approved equipment listed in [Appendix D](#).





11.2.1 Filter/Separators

The filter/separator is the primary device used at shore stations to keep aviation fuels clean and dry. Filter/separators shall be qualified to API/IP Spec 1581 edition 5.

Note

- Installations having filter/separator vessels qualified to earlier editions of API/IP Spec 1581 shall continue to use them with elements that meet the requirements of API/IP Spec 1581 edition 5. When replacement of such vessels becomes necessary, they shall be replaced with API/IP Spec 1581 edition 5 filter/separator vessels.
- Installations having filter/separator vessels qualified to MIL-F-8901 may continue to use them. MIL-F-8901 filter/separator vessels shall be replaced by API/IP Spec 1581 edition 5 vessels as soon as practical.

Filter/separators shall be provided at the following locations:

1. In receiving lines upstream of all operational storage tanks (i.e., those tanks from which product can be pumped directly to aircraft).
2. In supply piping (downstream) from storage tanks to aircraft refueler truck fill stands.
3. On any discharge (downstream) side of transfer pumps that supply aircraft or refuelers.
4. On any equipment that directly fuels aircraft (e.g., mobile refueling equipment, direct fueling [pantograph or hydrant] systems, and portable/temporary fueling systems).

Filter/separators should be provided at the following locations:

5. The main receiving points (upstream) of the bulk storage tanks. This will minimize receipt of water and sediment/particulates into bulk storage tanks and maximize time between tank cleaning. (The installation of a filter/separator is not practical at all receiving points; however, some device for the removal of sediment/particulates should be used depending on the method of delivery and flow rate involved.)

All metal downstream of a filter/separator vessel that is installed in a system designed to deliver fuel directly to an aircraft, along with that portion of the filter/separator that is in contact with the filtered fuel, shall be nonferric or stainless steel. Internally coated ferric materials are not acceptable downstream of the filter.

Each filter/separator vessel shall be outfitted with the following minimum accessories:

1. Manual water drain valve from the bottom of the water sump.
2. Automatic air eliminator valve.
3. Direct reading piston type differential pressure gauge with 1-psi graduations to measure the pressure differential across the elements. The gauge shall be mounted, free of vibration, so that the reading indicator will not fluctuate when fuel is being pumped under normal conditions.
4. Pressure relief valve.
5. Diaphragm-operated control valve on the main discharge line with a flow limiting pilot and a float operated pilot to close the main valve if the water level in the sump rises above the set point. This is also commonly referred to as a slug valve.
6. All manual water drains shall be connected to a portable or permanently installed recovery system. For environmental reasons it is recommended that pressure relief valves and air eliminator also be connected to a recovery system.
7. Head lifting device (for stationary installations only).





11.2.2 Relaxation Chambers

A chamber consisting of a tank or piping shall follow the filter/separator, which will allow static electric charges that develop as the fuel passes through the filtration media to “relax” before the fuel enters a tank. Since fuel must be in contact with the metal walls of the relaxation device for at least 30 seconds, the exact size of the relaxation tank or length of piping shall be determined from the maximum flow rate of the system. Only one relaxation chamber is needed for each filter/separator combination. Any tank, chamber, or other arrangement used to meet this requirement shall assure complete product turnover and shall have a water drain at its low point and manual or automatic air eliminator. Vessels shall be designed and constructed in accordance with Section 8 of the ASME Boiler and Pressure Vessel Code that is current at the time of vessel construction. The 30-second relaxation time requirement applies only to refueling systems and mobile equipment designed for fuel without Static Dissipater Additive (SDA) (e.g. JP-5 and JET-A).

11.2.3 Fuel Meters

Temperature compensated meters should be installed (NAVSUP, Publication 1, Volume II, paragraph 23087.9) at point of custody transfer. Meters used for service such as fueling aircraft, motor vehicles or boats, or for loading tank trucks or tank cars, shall be positive displacement meters. Turbine meters may be used for larger volume steady-state transfers such as loading ships, barges, or pipeline transfers. For shore-based systems, all meters shall meet the accuracy requirements of the National Bureau of Standards Handbook 44, Liquid Measuring Devices, latest edition.

11.2.4 Fuel Pressure Gauges

Pressure gauges shall be easy to read, accurate, and calibrated as required.

11.2.5 Sampling Connection†

Fuel sampling and pressure testing connections shall be installed at these locations: receiving points, tank outlets, inlet and outlet sides of filter/separators, the refueling nozzle, and at each side of a block valve so that the fuel remaining in each portion of a fuel transfer pipeline can be sampled. All sampling connections shall be flush-type, dry-break, quick disconnects with dust caps (i.e., Gammon fittings).

11.2.6 Hoses

All hoses and couplings used for aviation fuel service at shore activities should meet the requirements of EI1529/NFPA 407. This is a semi-hardwall, noncollapsible hose, type C. Diameter of the hose will be compatible with the desired delivery rate to aircraft. Unless otherwise specified, aircraft delivery hose on refueler trucks shall be a minimum of 50 feet in length.

Camlock hose couplings shall not be used downstream of the filter separators. Camlock hose fittings should not be used on mobile refueling equipment.

Shore-based hoses shall contain no electrical bond or bonding wire through the center of the hose, or in the carcass. Where two hose assemblies are attached to the same outlet or source of fuel, each shall incorporate its own shut-off valve in piping upstream of the hose.

11.2.7 Emergency Dry Breakaway Coupling†

An emergency dry breakaway coupling should be installed on the refueling hose at or near the place where the hose attaches to refueling equipment piping or hose reel. This device is required for each direct refueling system pantograph and recommended for all other installations.

11.2.8 Dry Break Quick Disconnect Coupling†

A dry-break, quick-disconnect coupling shall be installed at the nozzle end of the hose.

11.2.9 Hose End Pressure Regulator†

Each Single Point Refueling (SPR) nozzle assembly shall include a hose end pressure regulator set for a maximum of 55 psi.





11.2.10 Aircraft Refueling Nozzles†

1. Single Point Refueling (SPR) nozzles that meet the requirements of SAE AS5877 are approved for use ([Appendix D](#)).
2. Overwing nozzle (also referred to as “gravity” and “open port”) — nozzles shall meet the requirements of MIL-N-87963. Overwing nozzles shall have a tube spout suitable to the type of fuel and aircraft being serviced. Each over-the-wing nozzle shall have permanently attached a flexible bonding wire of suitable length terminating with a plug type connector (a clamp type connector may be used if it conforms to MIL-C-83413).

Nozzles may be interchanged on the same hose using the quick disconnect coupling. Nozzles shall be equipped with 60-100 wire mesh screen (0.25-0.15mm sieve) to trap particulates from the issue system. Nozzles shall have a dust cover in place at all times when not in use.

11.3 AIRCRAFT FUELING SYSTEMS

11.3.1 Aircraft Direct Fueling Systems

Aircraft direct fueling systems are designed primarily for “hot” refueling of aircraft. Aircraft direct fueling systems shall be installed only when authorized by COMNAVAIRFOR OR COMNAVAIRSYSCOM. NAVAIR/NAVFAC are available for assistance in sizing and locating direct refueling systems. New aircraft direct fueling facilities shall be constructed only for the issuance of jet fuels through the pressure refueling method utilizing SPR aircraft servicing nozzles to dispense the product. [Figures 11-1, 11-2, and 11-3](#) are simplified flow schematics of a shore activity's fuel system which reflects the design requirements of UFC 3-460-01.

Criteria for the construction of direct fueling systems will be based primarily on the following requirements:

1. The volume of rapid turnaround requirements for carrier aircraft, including rotary wing.
2. The volume of large, land-based patrol aircraft requiring average refueling of over 2,500 gallons.
3. The number of transport aircraft, with limited ground time, which shall be refueled in place simultaneously with other loading and off-loading.

All direct refueling facilities shall have the following minimum features:

1. Filter/separator.
2. Relaxation chamber or equivalent piping configuration capable of providing 30 seconds of static relaxation from point of last filtration to the nozzle.
3. Diaphragm-operated primary control valve.
4. Remote, hand-held, deadman control for each pantograph or hose installed at each station.
5. Emergency pump shut-off switch.
6. Meter on each station outlet.
7. Recirculation/flushing capability of the nozzle and or hose/pantograph system.
8. Emergency dry breakaway coupling on each hose or pantograph.
9. Bonding/grounding cable. This requirement is considered satisfied if the fueling hose/pantograph system has continuity (10,000 ohms or less).





Figure 11-1. Shore Activity Fuel System Flow Schematic

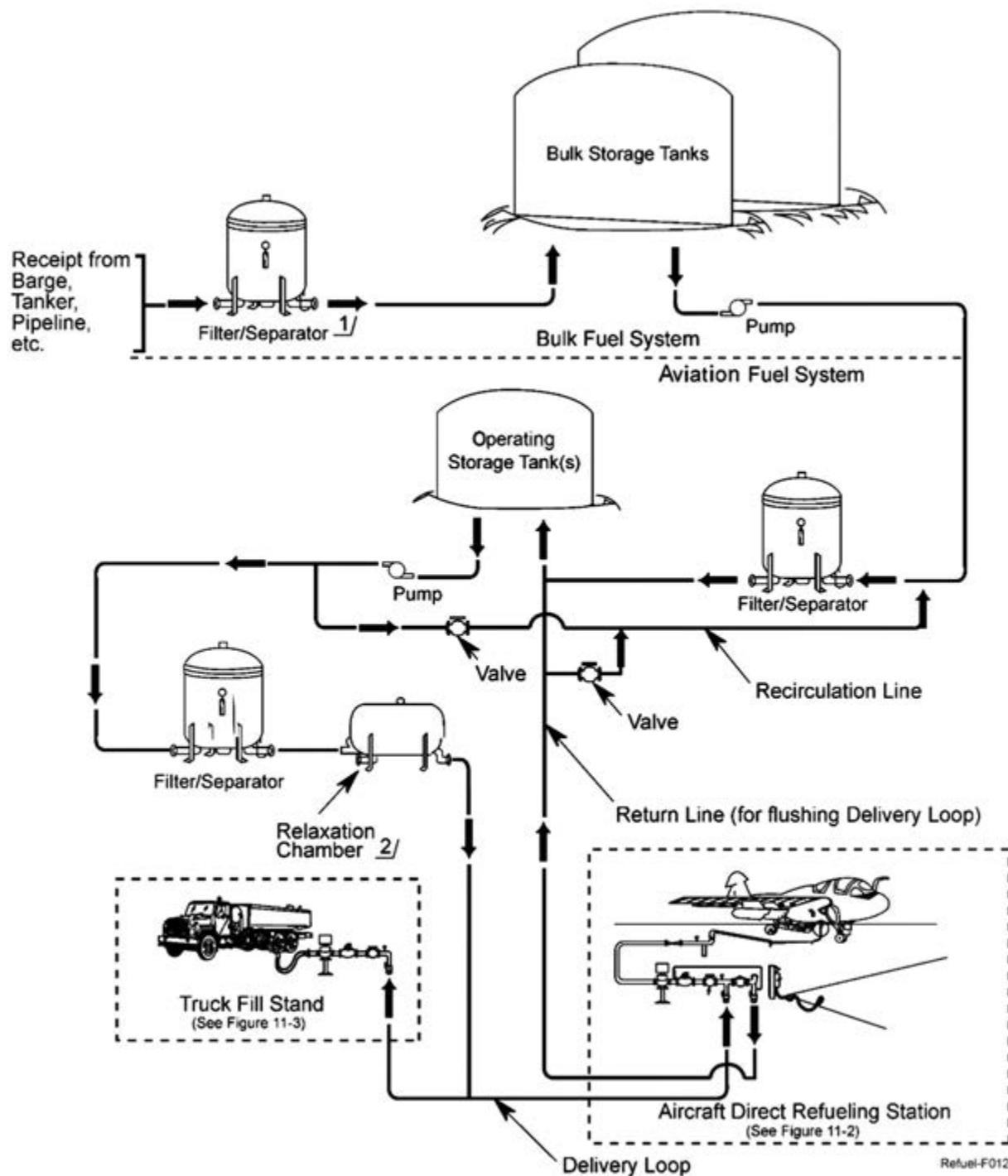




Figure 11-2. Aircraft Direct Refueling Station

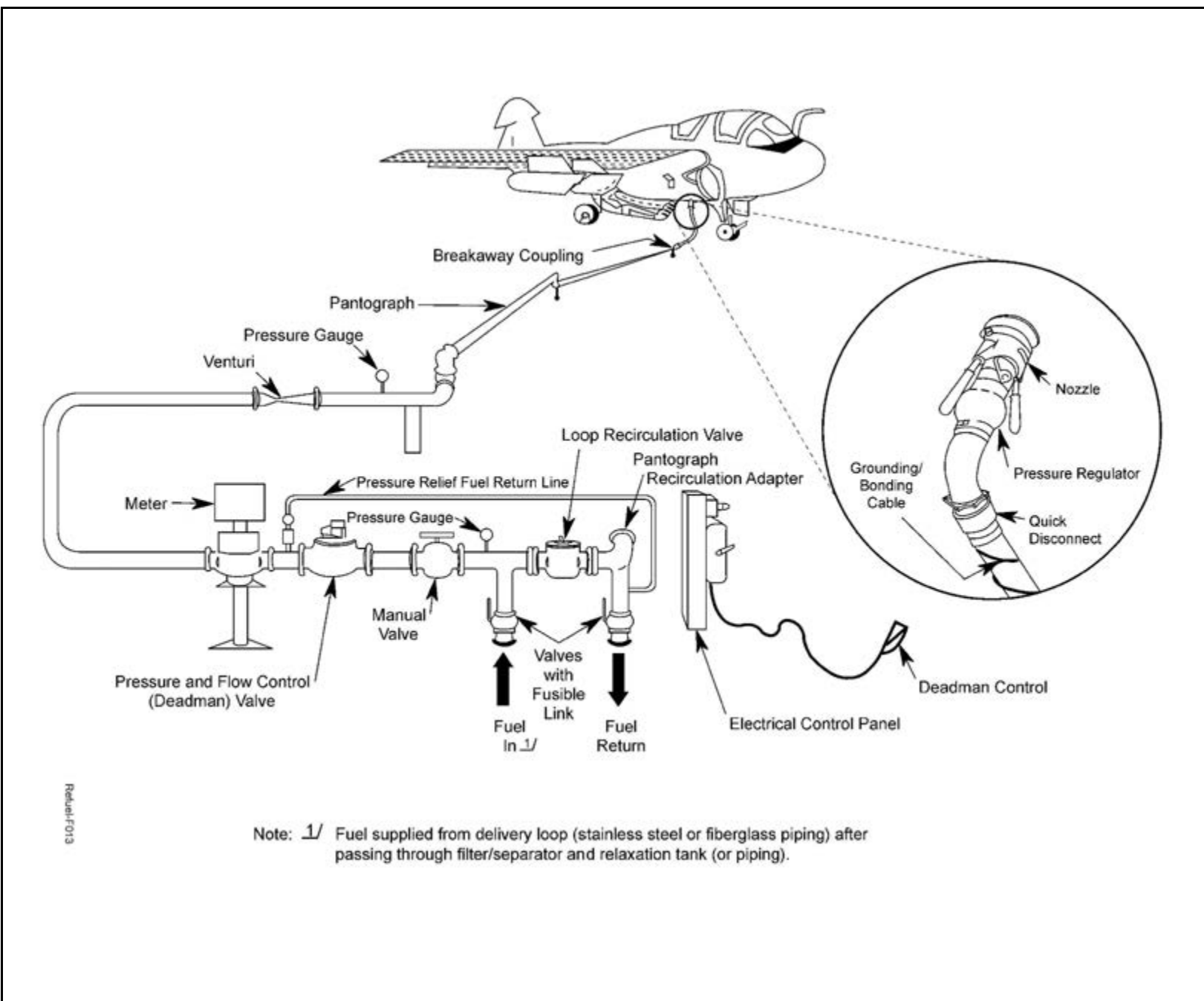
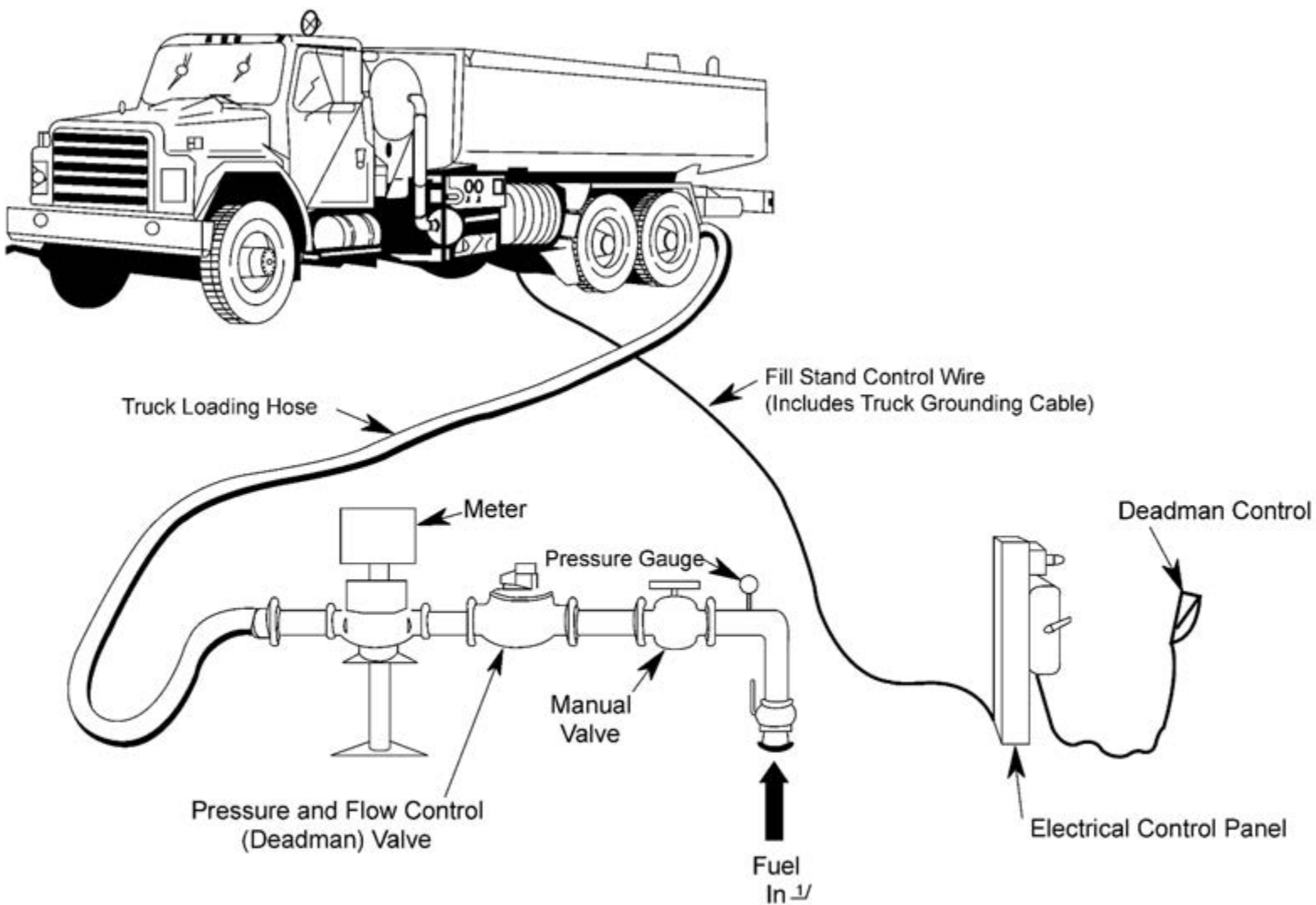




Figure 11-3. Truck Fill Stand



Note: ^{1/} Fuel supplied from delivery loop (stainless steel or fiberglass piping) after passing through filter/separator and relaxation tank (or piping).

Refuel F014





10. Pantograph and/or hose with approved, non-lubricated swivels. Zerk-type grease fittings in pantograph swing joints are not authorized.



The use of swivel joints with zerk grease fittings is prohibited since they can contaminate the fuel with grease.

11. Dry-break, quick-disconnect fuel service coupling with 60-100 wire mesh screen (0.25-0.15mm sieve).
12. Single point pressure refueling nozzle with a 55-psi max pressure regulator.
13. Fire extinguisher(s) in accordance with NAVAIR 00-80R-14 (minimum of one, 150-pound Halon, TAU or Rapid Intervention Vehicle (RIV) unit per fueling point).
14. Emergency eyewash/shower system available in the immediate area.
15. Fire alarm.

Note

Direct refueling systems shall not use or incorporate eductor systems.

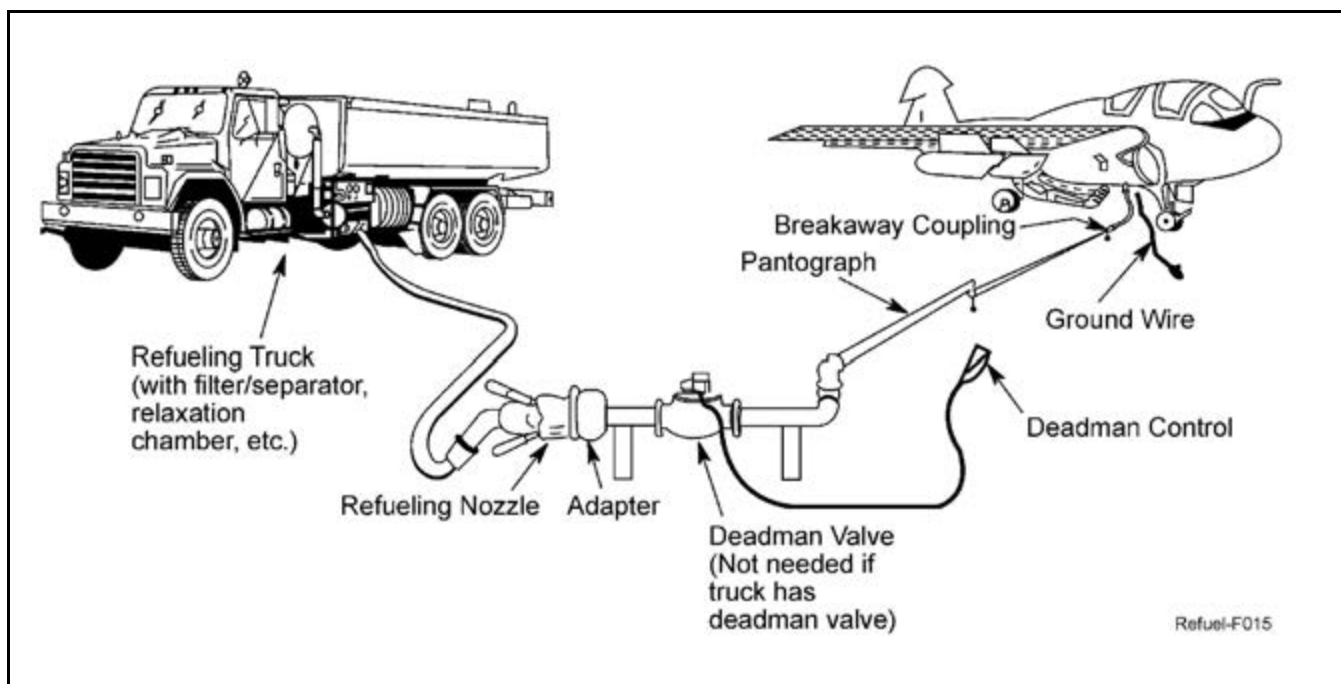
11.3.2 Mobile Aircraft Refuelers

Mobile refuelers are used primarily for cold refueling operations, with occasional hot refueling operations at stations where installation of a direct refueling system is not justified. If continuous or extensive hot refueling is being performed with mobile refuelers, the use of an anchored pantograph shall be required (see [Figure 11-4](#)).

Note

An emergency dry breakaway coupling is required if mobile refueling equipment is being used for hot refueling operations.

Figure 11-4. Hot Refueling with Truck and Pantograph





Mobile aircraft refuelers vary in capacities and configurations; however, whether contractor or Government owned, all shall have the same basic requirements. Refuelers shall comply with NFPA 407 in addition to the minimum requirements listed below.

All military and contract refuelers shall have the following minimum requirements:

1. Tank construction shall consist of one compartment only, with necessary baffles. Tank shall completely drain at low point without traps of liquid remaining in pockets. The tank shall be designed so that all portions are accessible for cleaning and maintenance.
2. Tanks shall be aluminum or stainless steel.
3. Tank top opening(s) shall be semipermanently secured and used only for inventory purposes and interior inspections and repairs. Manhole covers shall incorporate a fusible plug or plugs, each equipped with fine screens, to provide additional emergency vapor release.
4. Tank shall be configured for bottom loading. The bottom loading hardware shall include a cutoff valve, a MIL-A-25896 adapter to accept the standard SPR nozzle, and be of sufficient size to receive product at 600 gallons per minute. A fill stand anti-driveaway device shall be incorporated.
5. Overfill Prevention Equipment (OPE) on each mobile refueler placed in service or contracted shall be equipped with overfill prevention, ground verification, and Truck Identification Module (TIM). The OPE shall consist of an automatic electronic continuous self-checking system with dual level overfill prevention to include high and high-high liquid level sensing. The OPE system must be compatible with the system installed at the fuel facility and incorporate an anti-driveaway feature. The OPE system shall have a pre-check feature to ensure the automatic high-level shutoff system is functioning properly. The high level liquid sensor will be the primary method of shutdown at the fill stand. The high-high level liquid sensor will be the secondary method of shutdown on the truck to include defuel operations, both shall cause the internal tank valve to close and sound an audible alarm.

Note

When defueling or filling at a location without fill stand OPE (e.g., aircraft or hydrant systems) the high-high feature on the truck will be the only method of shutdown and there is no ground verification or TIM functions. Traditional bonding/grounding shall be required.

6. The piping system, including all hardware components, shall be capable of dispensing fuel at rated flow.



The use of swing joints with Zerk-grease fittings is prohibited since they can contaminate the fuel with grease.

7. Filter/separator.
8. Relaxation chambers.
9. Pressure and differential pressure gauges.
10. Meter (temperature compensating meters are desired).
11. Approved aircraft refueling hoses.
12. Dry-break, quick-disconnect coupling.
13. Hose end pressure regulator.
14. Approved aircraft refueling nozzles.



**Note**

Refueler/defuelers shall have two separate hose/SPR nozzle assemblies — one that includes a hose end pressure regulator, for refueling service, and one without, for defueling operations.

15. Bonding cable with clamp that conforms to MIL-DTL-83413/7.
16. Aircraft fuel servicing vehicles shall have at least two fire extinguishers installed — one on the left (drivers) front side readily accessible from the operator (refueler control panel) position; the other extinguisher on the right rear portion of the vehicle. Each extinguisher shall have an ANSI rating of not less than 20-B.

Note

The use of Halon is recommended since it is superior to CO₂ and is less corrosive than PKP.

17. Remote, hand-held, deadman control.
18. The exhaust of all engines (except turbo-diesel engines), including auxiliary engines, shall be equipped with a suitable spark arrestor. When replacing defective exhaust system components, use only authorized replacement parts.
19. Identification number on each side and on the roof. Tractor-trailer combinations will display side tank trailer numbers only (tractor may be interchanged). Side numbers will be a minimum of 16 inches in height and conspicuously located. Roof numbers will be a minimum of 24 inches in height and affixed with their bases toward the front of the vehicle. The identification numbers should provide sharp color contrast to the vehicle color.
20. A yellow flashing light that is mounted on the uppermost part of the vehicle structure. The light must be visible from any direction, day and night, including from the air.

11.3.3 Portable Fueling Systems

These air transportable, advanced base systems are used primarily to support tactical operations. They include the Tactical Airfield Fuel Dispensing System (TAFDS), Helicopter Expedient Refueling System (HERS), and Navy Advanced Base Functional Components Fueling Systems (ABFC-H14K). These systems are described in [Chapter 17](#) of this manual. With the exception of the ABFC-H14K, these systems shall be operated and maintained in accordance with [Chapters 18](#) and [19](#) of this manual. Since the ABFC-H14K possesses all of the required equipment, it shall be operated and maintained in accordance with [Chapters 12](#) and [13](#).

11.4 PORTABLE CLIMATE SHELTERS

Portable Climate Shelters (PCS) that are open on all four sides do not represent confined spaces. Open on all four sides is defined as two sides tall enough to taxi aircraft straight through and the remaining sides at least six feet from the ground.

Note

Aircraft can undergo cold fuel servicing in sun shades and sun shelters if the shades/shelters have no electrical provisions/equipment. If the shades/shelters have electrical provisions/equipment, they must meet NEC Class I, Division 2 requirements or be completely deenergized prior to fuel servicing. (Centralized Aircraft Support Equipment may remain energized, but electrical switches must not be operated.)





11.5 AIRCRAFT DEFUELING EQUIPMENT

11.5.1 Refuelers/Defuelers

The most ideal and cost-effective method of handling nonsuspect defueled aviation turbine fuel is to reissue it to an aircraft. Most facilities that handle sizeable quantities of such fuel have designated one or more aircraft refueling trucks as “refueler/defuelers.” The opening of manholes during defuel operation is prohibited.

WARNING

Opening the manhole cover presents several dangers including the possible introduction of ignition sources into the flammable vapor space of the tank as well as contaminants into the fuel.

In addition to the requirements for refuelers, refueler/defuelers shall meet the following minimum requirements:

1. Refuel/defuel trucks shall carry the marking “JET FUEL/JP” in place of the normal markings (e.g., “JP-5 JET FUEL F-44”, “JP-8 JET FUEL F-34” or “JET FUEL F-24”).
2. Defuel capability that passes fuel through the pump, filter/separator, relaxation chamber (fuel without SDA), and meter before it enters the tank.
3. Separate hose and nozzle assemblies shall be provided on refuel/defuelers for each of the two different operations — refueling and defueling.

Note

Eductor-type systems or hose evacuation systems shall not be used for operations since they allow unfiltered fuel to be issued to the next aircraft.

4. A pump with maximum defuel rate of 100 gpm and vacuum not to exceed -7 psi.
5. High level alarm. (A high level cutoff system is highly recommended.)

11.5.2 Defuelers

These units are used for defueling only. Fuel placed in a defueler shall not be directly reissued into an aircraft since it is generally configured without filtration equipment and the fuel placed in a defueler unit is often suspect. Fuel in a defueler shall be sampled and tested to determine disposition.

Defuelers shall meet the following minimum requirements:

1. Trucks used exclusively for defuels shall carry the marking “DEFUELS ONLY” in place of normal markings.
2. A pump with maximum defuel rate of 100 gpm and vacuum not to exceed -7 psi.
3. A cutoff or alarm system for overfill protection that has at least one of the following:
 - a. Jet sensor.
 - b. Float high level.
 - c. Fiber optic or thermistor probe.
4. Defuel hose and nozzle shall meet the requirements of [paragraphs 11.2.6 and 11.6](#).

Hose evacuation systems shall not be used for defueling.





11.6 AIRCRAFT REFUELER TRUCK FILL STANDS

The number of truck fill stands required for each product is a function of the filling time and the number and capacities of refuelers necessary to sustain aircraft refueling services within the established turnaround times.

Note

Bottom loading fill stands are the only type authorized for use. Top loading is not authorized.

Overhead truck fill stands are no longer authorized for any petroleum product. The loading rack shall have a separate loading system for each grade of product to be handled. All truck fill stands, regardless of the type of fuel dispensed, are classified as Class 1, Group D Hazard areas as defined by NFPA and shall therefore comply with the regulations governing such areas.

Minimum equipment required at a truck fill stand for aviation fuel is:

1. SPR nozzle with dry break quick disconnect and strainer.
2. Loading hose, API 1529 type III, approximately 10 feet long or mechanical loading arm with non-lubricated swivels.
3. Loading hose fuel thermal pressure relief valve.
4. Diaphragm operated, two-stage control valve (low flow/high flow) with adjustable time delay to prevent the high flow pilot from opening until 1 minute after start of fuel flow.
5. Meter with rated capacity equal to the maximum flow rate of the loading station. Temperature-compensated positive displacement meters are recommended.
6. Filter separator†.
7. Relaxation tank or equivalent piping†.

Note

The above requirements marked with a dagger (†) will automatically be met if the truck fill stand is a spur of the direct fueling system downstream of the filter separator and relaxation chamber. All piping after the filter separator to the fill stand shall be non-ferrous or stainless steel.

8. Shutoff valves for maintenance.
9. Sample outlet.
10. Overfill Prevention Equipment (OPE). For ease of operation and increased safety, truck fill stands shall be equipped with an overfill prevention system that incorporates the following: self-monitoring, automatic tank fill shut-off; bonding; ground verification, Vehicle Identification Prover (VIP); and hand-held deadman control. The installed OPE shall have control of the starting and stopping of fuel flow. Full implementation requires incorporation of companion connectors on all station refuelers.
11. Low intensity instrument lighting to permit full visibility of all equipment and controls during night operations.
12. Spill containment system that will prevent the run-off of fuel in the event of tank rupture or major spill during loading operations. Concrete shall be used instead of asphalt because spilled fuel or fuel leaks deteriorate asphalt surfaces.

Note

Recommend that slopes over containment curbs be no more than 2 percent.

13. Overhead lighting in the immediate truck fueling area.





11.7 TRUCK PARKING AREAS

11.7.1 Condition of Truck Parking Areas

Each activity shall have adequate truck parking areas accessible by good roads. Both the parking area(s) and the access roads shall be paved and maintained in good condition. Parking areas shall be free from chuck holes and ruts, which cause refueler damage and FOD. In addition, refueler parking areas shall be contained by appropriate curbing, dikes, retention ponds, or drainage to oil/water separators (the preferred method). The method used shall be sized to contain the largest vessel normally parked within the area. The use of concrete is preferred over asphalt because spilled fuel or fuel leaks deteriorate asphalt surfaces.

11.7.2 Refueling Vehicle Parking Area Requirements

Fuel servicing vehicles shall be parked in designated parking areas. Fuel servicing vehicles shall be positioned so that they are free to exit the designated parking areas without backing up or abnormal maneuvering to avoid structures such as buildings, pipelines, fill stands, and other equipment. Activities shall have sufficient truck parking spaces to allow:

1. A minimum of 25 feet between the centerlines of adjacent fuel servicing vehicles when in the parked position.
2. No trucks to be parked closer than 100 feet to any inhabited building.
3. Separate entry/exit gates designed to facilitate one-way traffic patterns within the parking area.
4. Free and direct egress from the parking area of any truck at all times. No object or another truck may block or hinder the egress of any of the trucks parked in an area. This means absolutely no backing, no jack-knifing, no additional maneuvering.
5. Security fencing to preclude unauthorized unintended entry into the refueler parking area if the fuel compound is not already fenced. Vehicle/personnel gates shall be secured. Remote control gates with driver operated control devices are recommended. Fuel servicing vehicles shall not be parked within the clear zones of security fencing.
6. Security lighting capable of illuminating the entire refueler parking area.
7. Spill containment system that will prevent the run-off of fuel in the event of tank rupture or major spill. Concrete shall be used because spilled fuel or fuel leaks deteriorate asphalt surfaces.

Note

Recommend that slopes over containment curbs be no more than 2 percent.

11.8 RECEIVING STATIONS

Fuel can be received by pipeline, barge, railroad tank car, tank truck, or any combination thereof. Receiving stations are tailored to the method, quantities, and rates of fuel delivery. Aviation fuel should be received through a filter/separator or other appropriate filtration device. This is an essential requirement when fuel is received directly into an air station's or facility's operational storage tanks. Weight handling equipment may be necessary in conjunction with barge receipts in order to facilitate large diameter hose handling. Communications equipment may be necessary for barge or pipeline receipt to coordinate an uninterrupted product flow. Appropriate environmental protection equipment, facilities, and procedures shall be provided in order to comply with Federal, State, and local environmental laws.

11.9 STORAGE TANKS

Tanks located at air activities provide the operating supplies of aviation fuel for aircraft. Storage tanks can be classified as bulk storage or operational storage.

All tanks shall comply with the following requirements:





1. All operational steel tanks shall be 100 percent coated with an inert material such as polyurethane or epoxy. All bulk steel fuel storage tanks shall be coated on the bottoms and up 1 meter (38.6 inches) on the sidewalls. All concrete tanks storing aviation fuel shall be 100 percent lined on the floor and sidewalls to make them impervious to fuel.
2. All aviation turbine fuel operational storage tanks shall be equipped so that the fuel can be circulated through a filter/separator and returned to the tank, thus removing any bottom sediment/particulates and water. Outlets must be at lowest point of tank to eliminate water bottoms. All aviation fuel tanks shall also be equipped with a water stripping system.
3. Tank roofs shall be in good repair and not allow rain water to enter.
4. Tank repair projects shall conform to UFC 3-460-01.
5. Fill connections for all types of tanks shall be sized so that the velocity of the fuel during filling shall not exceed 3 feet per second. Inlets shall discharge fuel horizontally near the bottom of the tank.
6. All bulk storage tanks shall be equipped with adequate sumps, drain lines, and water drawoff lines such that tank water bottoms can be kept at an absolute minimum. Recovery tanks that remove water and recover fuel are recommended for environmental reasons.
7. All tanks shall be fitted with automatic gaging devices and high and low level controls in order to prevent the overfilling of tanks and the exposure of pumps to cavitation.
 - a. Gauging devices. The automatic gauge shall be a float or similar device with a readout that is readily accessible and visible at eye level from the ground immediately adjacent to the tank. The readout shall be of a type that is compatible with a remote reading system.

Note

Float-type gauging devices shall not be used for custody transfer/inventory purposes.

- b. High Level Alarms and Automatic Shutoff. Two high level alarms and automatic shutoffs shall be provided.
 - (1) High Level Alarm (HLA) shall be set at approximately 95 percent of the safe tank filling height arranged to actuate an audible alarm signal located at or near the normal station of the person in control of the tank filling operation. Remote alarms shall be located where they can be monitored at all times.
 - (2) A high level shut-off valve that is mechanically actuated to stop the flow into the tank is located between the HLA and the High-High Level Alarm (HHLA).
 - (3) HHLA shall be set at approximately 98 percent of safe filling height. It shall continue the audible alarm and in addition, actuate a visible alarm.
- c. Low Level Alarms. The low level alarm shall actuate an audible alarm that is distinctly different from the high level alarms and stop product transfer pumps.

WARNING

Alarms shall be left in active mode at all times.

8. All above ground tanks shall be surrounded by an enclosure that is capable of holding the entire above ground capacity of the tank plus one foot freeboard, in the event the tank should rupture or leak. This is usually accomplished with impermeable dikes.
9. Except when physically draining dikes, dike drains shall remain closed and locked.
10. Other environmental facilities/equipment as necessary to comply with Federal, State, and local laws.





11.10 TRANSFER LINES

Fuel passes through transfer pipelines of varying diameters and construction materials in its route from tank-to-tank, storage-to-truck fill stands, and storage-to-hydrant systems. Transfer lines shall not leak or introduce excessive contaminants to the fuel. To reduce iron contamination in fuel, use of internally coated pipe or other noncorrosive materials in these lines should be considered.

11.11 FUEL DIVISION SPACES

11.11.1 Fuel Office

An office with sufficient space to perform the necessary planning, administrative, and management functions associated with the accomplishment of the Fuel Division's mission is essential. The office can be shared by the FMO, assistant FMO, and administrative staff. In the latter instance, to prevent the appearance of a conflict of interest, a partitioning that affords a degree of privacy to both the Government and contractor personnel is required. At smaller activities that do not require a formal dispatcher's desk, the fuels office can be the work center for aircraft refueling operations; however, in such instances it shall be connected to the fuels crew ready room by an intercommunications system.

11.11.2 Fuel Crew Ready/Training Room

The fuels crew ready/training room should include the following minimum equipment:

1. Dispatch desk.
2. Climate control suitable for facility location.
3. Classroom with:
 - a. Chairs.
 - b. Blackboard.
 - c. Display board.
 - d. File cabinet.
 - e. Book shelves or cabinets for publications.
4. Lockers and dressing room.
5. Toilet and shower facilities.
6. Phone and other communications equipment.

11.11.3 Fuel Workshop

The workshop should contain a good sized and convenient workbench with compressed air and electrical outlets available. Adequate storage space for frequently used tools, spare hardware items, and accessories shall be provided adjacent to the workbench.

11.11.4 Fuel Division Storeroom

An adequate storeroom for spare hoses, nozzles, filter elements, special tools, special clothing, test equipment, and fuel spill clean-up equipment is required. Size and location are determined by each facility but the key is to provide sufficient space for orderly storage and location for ready access to needed material by fuels division personnel.

11.11.5 Fuel Division Laboratory

The fuel laboratory size and associated equipment depend upon the scope of the quality surveillance and testing program performed. The laboratory shall be in accordance with applicable NFPA codes. The absolute minimum laboratory requirements for an activity that refuels aircraft are:





1. Lighting and fixtures in accordance with NFPA 70 (explosion risk shall be assessed on the basis of handling JP-4 and/or AVGAS, in addition to JP-5).
2. Climate control (e.g., air-conditioning/heating).
3. Sink with running hot and cold water. In accordance with UFC 3-460-01.
4. Workbench(s) or counter(s) of sufficient size to accommodate and maintain all required test equipment in a ready-to-use position. The countertops shall be composed of a nonpermeable material suitable for working with petroleum fuels. Laboratory flooring material shall also be impermeable and suitable for a fuels laboratory.
5. Storage cabinets for samples and test equipment support items; for example, bottles, drying rack, spare millipore pads.
6. Hydrometers.
7. CFD. Several versions of this device, referred to by different names, are currently in use. The CFD, the AEL Mark III, or the Combined Contaminated Fuel Detector (CCFD) are all acceptable.
8. FWD.
9. B/2 Anti-Icing Test Kit.
10. Pensky-Marten Flash Point Tester or NAVIFLASH/MARFLASH.
11. Fume hood.

Note

Each activity should possess at least two CCFDs and two FWDs in operating condition. Aircraft refueling operations shall not be performed if fuel contamination levels cannot be routinely tested as required by [Chapter 9](#) of this manual.

12. An OSHA emergency eyewash and shower supplied with tepid water in accordance with ANSI/ISEA Z358.1. Type C labs require only an eyewash.
13. Outward opening doors with panic bars.
14. Portable firefighting equipment.
15. Telephone.
16. Fire alarm box.
17. Spill Control Kit.

11.12 MISCELLANEOUS FUEL DIVISION SAFETY EQUIPMENT

Fuel tank farm areas and transfer points shall contain adequate firefighting, fire alarm, and emergency eyewash/shower equipment as specified by applicable NFPA codes.





CHAPTER 12

Operating Procedures for Shore Activities

12.1 INTRODUCTION

This chapter establishes minimum operating procedures to assure safe handling of aviation fuel. The operating procedures presented and discussed in this chapter are for general types of fuel facilities and equipment common to all or most activities engaged in the fueling of aircraft. They include the basic steps that, for safety reasons, must be performed with each fuel handling operation with particular emphasis on the fueling of aircraft. Any departure from the procedures of this chapter may adversely affect the overall safety of the operation being performed.

WARNING

Refueling personnel shall discontinue any fuel operation that does not appear to be progressing in a normal fashion (e.g., appears to be taking much longer than would normally be expected, or pressures are too high, etc.) or when a safety violation is in evidence, and shall immediately notify the FO or FMO. Failure to recognize and terminate such an operation can lead to a catastrophic accident.

The operating procedures presented and discussed in this section are for general types of fuel facilities and equipment common to all or most activities engaged in the fueling of aircraft. Since the actual facilities and equipment vary greatly from installation to installation, these procedures and accompanying information are designed to serve as a basic outline and guide to the FMO in the preparation of detailed, written, operating instructions for the utilization of the equipment and facilities under his jurisdiction. This is one of the FMO's most important and technically demanding responsibilities. No deviation shall be made from the procedures contained in this chapter without the full cognizance of the FMO. In those situations where abnormal fuel operations are required, the FMO will determine whether or not to proceed with the proposed action. Assistance is available to the FMO in accomplishing this task from NAVFAC, NAVAIR (Code AIR-4.4.5), the NAVSUP Energy Office, and/or the TYCOMs.

12.2 GENERAL OPERATING PROCEDURES

Fuel delivery equipment shall be operated by qualified fuel personnel and shall not be subcustodied to other than fuel management organizations. The following procedures are general in nature and shall be applied to all operations performed by each unit/activity engaged in the fueling of aircraft.

12.2.1 Spill Prevention and Control

Proper training of fuel servicing personnel is essential. Proper maintenance of the equipment is equally essential. Leaking or malfunctioning equipment shall be removed from service. Self-closing nozzles or deadman controls shall not be blocked open or bypassed. Kinks and short loops in fuel hoses shall be avoided. In addition, a fuel spill/fire prevention drill must be conducted at least quarterly in accordance with 29 CFR 1910.

When a spill is observed, the fuel servicing shall be stopped immediately by release of the deadman control, by closing the nozzle handle, or by operation of the emergency fuel shutoff. The supervisor shall be notified at once and the operation shall not be resumed until authorized by the supervisor. Every fuel spill shall be investigated to determine the cause, whether emergency procedures were properly carried out, and what corrective measures are required.





12.2.1.1 Priming Spills

Pint-size spills, involving an area less than 18 inches in any dimension, require no emergency action during cold refueling operations; however, ramp personnel shall stand by with a fire extinguisher until operations are complete and/or the aircraft departs. A spill or leak of any size is cause for terminating a hot refueling operation.

12.2.1.2 Small Spills

Other small spills involving an area of from 18 inches to 10 feet in any dimension shall have a fire guard posted, equipped with at least one fire extinguisher. Either absorbent cleaning agents (such as diatomaceous earth) or emulsion compound may be used to absorb the spilled fuel. Contaminated absorbent shall be placed in metal containers with closed lids until they can be removed and disposed of in accordance with local hazardous waste disposal procedures. An exception to this method may be authorized if the spill occurs in an area where no operations are in progress or will be conducted until ample opportunity is provided for volatile fuels to evaporate harmlessly. In such an event, the area shall be roped off. Fuels such as JP-5, which will not evaporate readily, shall be removed by one of the methods indicated above.

WARNING

Fuel contact can adversely affect some types of ramp surfaces.

12.2.1.3 Large Spills

Large spills covering an area greater than 10 feet in any dimension or over 50 square feet in area, require handling by the Spill Response Team. The team shall be summoned immediately and all other personnel evacuated to a safe distance. No one shall be permitted to walk through the liquid area of a fuel spill.

Note

The above spill size designations are general. Local regulations may be more stringent.

12.2.1.4 Navy Oil Discharge Response

All fuel spills shall be reported immediately to the activity's environmental coordinator in accordance with the local oil spill contingency plan.

Note

- All fuel handling personnel shall be familiar with the local oil spill contingency plan.
- All FMOs shall be thoroughly familiar with OPNAVINST 5090.1.

12.2.2 Surge Pressure Control

All fuel handling procedures shall be designed to minimize surge pressure. The following actions will help to accomplish this:

1. Close all valves slowly, particularly during the last half of the closure.

WARNING

Even during an emergency such as a hose or pipeline leak, valves shall be closed slowly. Rapid closing of a valve can create a surge pressure of sufficient magnitude to rupture pipes or systems.





2. Pressure gauges shall be installed in critical places on the flow-inlet side of controlling valves so the operator can keep pressures within limits as the valve is closed.
3. Start and stop booster pumps with bypasses opened, if there is such a provision; then slowly close them.
4. In multiple pump operations, start and stop pumps one at a time.
5. In starting an operation, open the downstream valve first and work toward the pumping source.
6. In stopping an operation, reverse the above and close the upstream valve first.
7. Fill all empty or partially empty lines slowly, particularly a line system involving steep slopes.
8. Where practical, keep both receipt and issue pipelines packed.

12.2.3 Night Vision Goggles

Use of night vision goggles during refueling operations shall be in accordance with local procedures.

12.3 REFUELING AIRCRAFT AT DIRECT FUELING STATIONS WITH ENGINES OFF (COLD REFUELING)

Each activity shall record its direct refueling operations with a log similar to [Figure 12-1](#).

12.3.1 Pressure Refueling

12.3.1.1 Personnel Requirements

Refueling aircraft in static condition at fueling hydrants, direct refueling stations, skid mounts, and other fuel service units requires a minimum of two people trained and certified in accordance with [Chapter 8](#) — a nozzle operator and a fuel system operator who will also perform the duty of a fire extinguisher operator.





Figure 12-1. Direct Refueling Station Log

DIRECT REFUELING STATION LOG						
Refueling Station (Pit) #:				Date:		
Time	A/C			Quantity Issued (Gallons)	SQDN Signature	Station Operator's Initials
	Type	BuNo #	SQDN			





12.3.1.2 Procedures

WARNING

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

Aircraft refueling tasks are to be performed in the following sequence and verified by the pit station operator:

1. Recirculate/flush the station and take fuel sample for quality control checks as appropriate. (station operator)

WARNING

Fuel shall be recirculated/flushed through refueling hose and nozzle, and tested for contamination prior to refueling the first aircraft each day. Fueling shall not begin until acceptable results have been obtained (e.g., clear and bright with no visible sediment/particulates [see [Chapter 9](#)]). Failure to provide clean, dry fuel to the aircraft can adversely affect safety of flight.

2. Check for hot brake condition. (plane captain)

Note

Hot brake check is applicable to fixed-wing aircraft, or as required.

3. Tow aircraft into the direct refueling station, chock it, and secure the engine. (plane captain)

CAUTION

Aircraft shall be parked in the refueling area so that the DFS hose does not pass underneath or around the aircraft to reach the refueling receptacle.

Note

- Aircraft shall not be cold refueled simultaneously while conducting hot refueling at the same direct refueling station.
 - If an aircraft is towed in the refueling area and the tractor remains attached, its engine shall be secured until completion of the refueling evolution.
4. Secure all electronic and electrical switches on the aircraft not required for fueling. (plane captain)
 5. Verify the fire extinguisher is at the refueling point. (station operator)
 6. Prior to cold refueling aircraft carrying ordnance, qualified squadron personnel shall verify all ordnance is safed. Safed is defined as the replacement of any mechanical arming level, safety pin, electrical interrupt plug/pin, securing of armament switches, and/or any appropriate action that renders the particular ordnance carried as safe.

WARNING

- Refueling of aircraft with hung ordnance of any type is prohibited.
- Explosive loaded combat aircraft are not permitted in the fuel pits.





7. Attach bonding cable between the refueling equipment and the aircraft (see [Figure 12-2](#)). (plane captain)

Note

- In direct fuel systems, bonding is usually accomplished through the nozzle/hose/pantograph system (see [Figure 12-3](#)).
 - If bonding is not accomplished via the nozzle/hose/pantograph system, the bonding connection shall be made using the grounding receptacle near the aircraft's refueling adapter. If this is not possible, connection shall be to bare metal on the aircraft.
8. Pull out the pantograph (or reel out hose) and place in proper position for refueling. (nozzle operator and station operator)
 9. Remove refueling adapter cap from the aircraft and the dust cover from the SPR nozzle. Inspect the face of the nozzle to ensure it is clean and verify the flow control handle is in the fully closed and locked position. (nozzle operator)
 10. Visually inspect the aircraft's adapter (receptacle) for any damage or significant wear. If any doubt about the integrity of the adapter exists, use the adapter go/no-go gauge (NSN 5220-01-301-9247) or alternate go/no-go gauge (NSN 5220-01-343-1688, 5220-01-554-2538) to determine acceptability. (nozzle operator)

WARNING

A worn or broken adapter can defeat the safety interlocks of the refueling nozzle permitting the poppet valve to be in the open position when removed from the SPR adapter and fuel to spray or spill.

11. Lift nozzle by lifting handles, align the lugs with the slots on the aircraft adapter, and hook up to the aircraft by pressing it firmly onto the adapter and rotating clockwise to a positive stop. (nozzle operator)

WARNING

Nozzle must seat firmly on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system that can lead to a fuel spray or spill.

Note

Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. A defective or worn aircraft SPR can also be detected in this manner.

12. Zero the refueling station's meter or note the station's totalizer reading. (station operator)
13. Upon receiving signals from nozzle operator/plane captain that hook-up has been completed and fueling operation is ready to begin, station operator actuates the remote, hand-held, deadman control.

Once a fueling evolution has commenced, the aircraft's electrical power status and connections shall not be changed until evolution has been completed or refueling has been stopped for an emergency (e.g., no aircraft engines or APU shall be started or stopped and external power shall not be connected, disconnected, or switched on/off).



**WARNING**

- Changing the aircraft's electrical power status can create significant ignition sources.
- Deadman controls are not to be blocked open or otherwise compromised, as this will defeat the purpose of the device and can lead to a catastrophic accident.

Note

Switching off the F-35 28V battery does not provide a hazardous ignition source and is an acceptable procedure during refueling.

14. When hose is fully charged, rotate the nozzle flow control handle to the FULL OPEN position. The handle shall rotate 180 degrees to ensure the poppet valve is fully open and locked. (nozzle operator)

WARNING

The flow control handle of the single point pressure refueling nozzle shall be placed in either of two locked positions — fully open or fully closed. The handle is not to be used as a flag to indicate fuel flow. Excessive wear on the aircraft adapter and the fuel nozzle poppet will result if the handle is allowed to float in the unlocked position.

15. Once fuel flow has been established, exercise the aircraft's precheck system. (plane captain)

Note

- The precheck system simulates the completion of refueling by closing all of the tank shut-off valves within the aircraft. All fuel flow into the aircraft should stop within a few seconds to 1 minute of actuating the precheck system. On aircraft equipped with a fuel indicator, the primary means of detecting successful precheck is by observing the flow indicator on the aircraft to make sure that it stops. If the aircraft is not configured with a flow indicator, or if the aircraft flow indicator is inoperative, the only acceptable means of determining that precheck has been successful is to watch the fuel delivery system's flow counter (flow meter) to ensure it stops. A stiffening (or jerking) of the refueling hose or indication of a fueling pressure spike is not a suitable indication that precheck has successfully occurred (hose stiffening/jerking and pressure spikes can occur whenever one or more aircraft fuel tank refueling valves close).
 - Aircraft may be cold refueled if it fails precheck, but special procedures are required. See appropriate aircraft NATOPS manual. This should be done only if it is an operational necessity.
16. Fuel aircraft as directed by plane captain. Plane captain shall monitor aircraft vents, tank pressure gauge(s) and/or warning lights as necessary.
 17. When directed by the plane captain, release deadman control. (station operator)
 18. Rotate the nozzle flow control handle into the OFF and fully locked position. (nozzle operator and verified by the station operator)



**WARNING**

Failure to lock the flow control handle in the OFF position can contribute to a failure of the nozzle's safety interlock system and could result in a fuel spray or spill.

19. Disconnect nozzle from the aircraft adapter. (nozzle operator)
20. Stow the pantograph or hose. (nozzle operator and station operator)
21. Complete paperwork. (nozzle and station operators).

Figure 12-2. Bonding of Aircraft to Direct Refueling Station

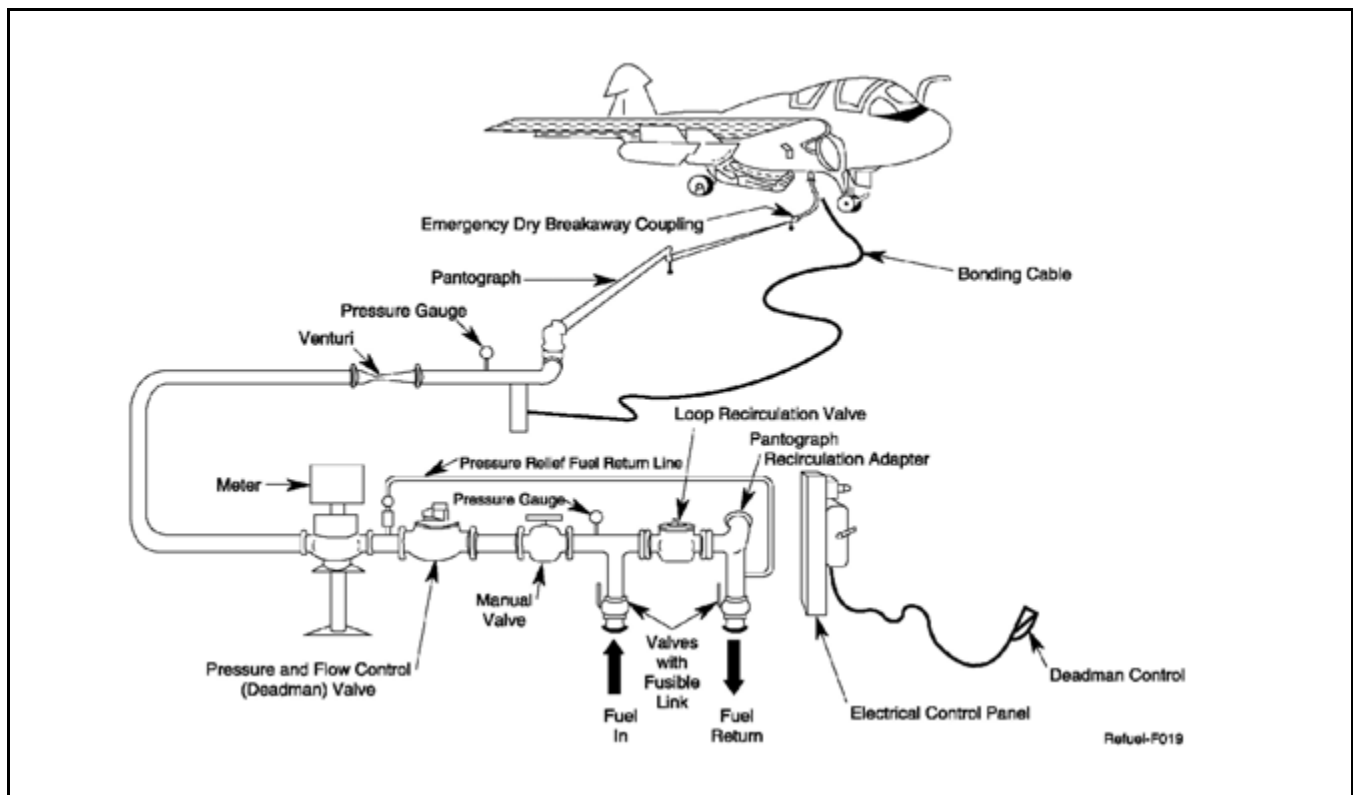
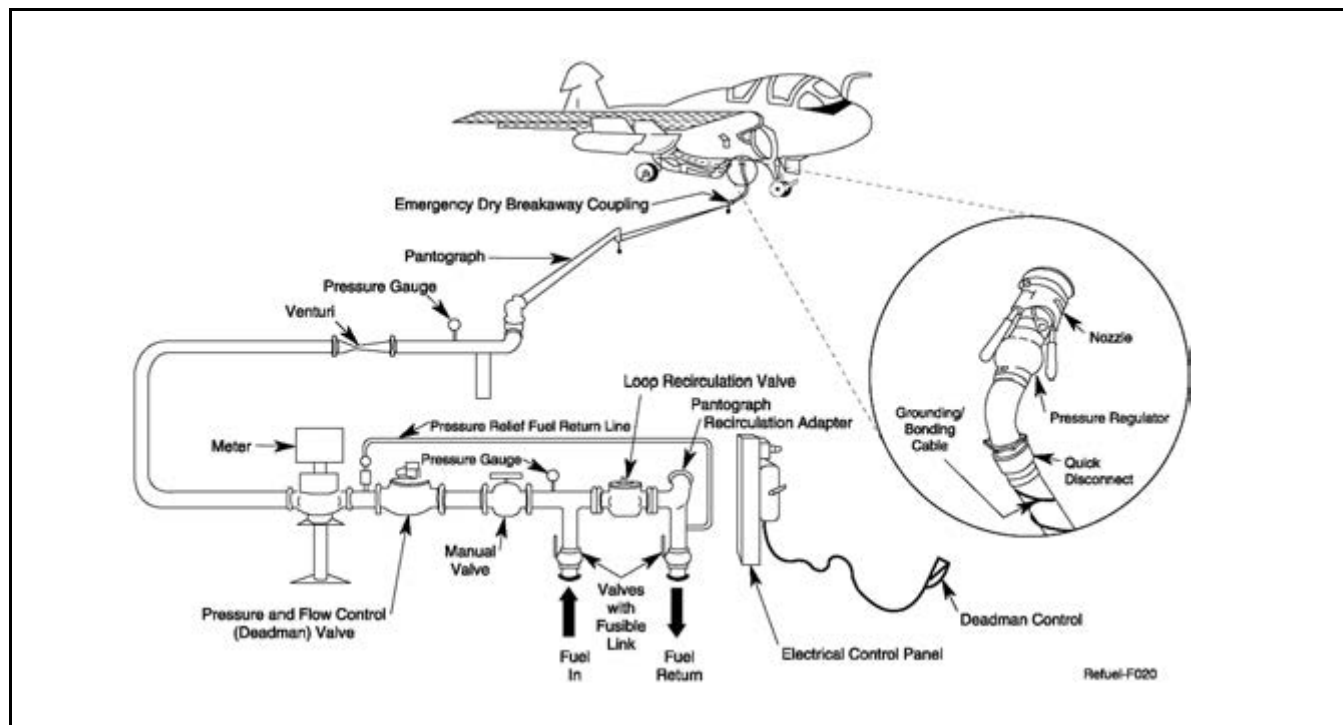




Figure 12-3. Bonding and Grounding Via Nozzle Connection



12.3.2 Overwing (Gravity) Refueling

12.3.2.1 Personnel Requirements

Overwing (gravity) refueling aircraft in static condition at fueling hydrants, direct refueling stations, skid mounts, and other fuel service units, requires three people — a nozzle operator, a fuel system operator, and a fire extinguisher operator.

12.3.2.2 Procedures

WARNING

- Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.
- Overwing refueling with the aircraft's engines operating is not authorized.

Aircraft refueling tasks are to be performed in the following sequence and verified by the pit station operator:

1. Recirculate/flush the station and take fuel sample for quality control checks as appropriate. (station operator)

WARNING

Fuel shall be recirculated/flushed through refueling hose and nozzle and tested for contamination prior to refueling the first aircraft each day. Fueling shall not begin until acceptable results have been obtained (i.e., clear and bright with no visible sediment/particulates) (see [Chapter 9](#)). Failure to provide clean, dry fuel to the aircraft can adversely affect safety-of-flight.



**Note**

Recirculate the refueling station and take samples with the SPR nozzle in place, then replace the SPR with overwing nozzle immediately before commencing refueling operations.

2. Check for “hot brake” condition. (plane captain)

Note

Hot brake check is applicable to fixed-wing aircraft, or as required.

3. Tow aircraft into the direct refueling station. Position and chock it. (plane captain)
4. Secure all electronic and electrical switches on the aircraft not required for fueling. (plane captain)
5. Verify the fire extinguisher is at the refueling point. (station operator)
6. Attach bonding cable between the refueling equipment and the aircraft. (plane captain)
Once a fueling evolution has commenced, the aircraft's electrical power status and connections shall not be changed until evolution has been completed or refueling has been stopped for an emergency (e.g., no aircraft engines or APU shall be started or stopped and external power shall not be connected, disconnected, or switched on/off).

WARNING

- Changing the aircraft's electrical power status can create significant ignition sources.
- Securing or attaching grounding connectors/cables to external doors, latches or hinges may cause a catastrophic accident.

Note

Switching off the F-35 28V battery does not provide a hazardous ignition source and is an acceptable procedure during refueling.

7. Zero the refueling station's meter or note the station's totalizer reading. (station operator)
8. Pull out the pantograph (or reel out hose) and place in proper position for refueling. (nozzle operator and station operator)
9. Bond the overwing nozzle to the aircraft as shown in [Figure 12-4](#) and then remove the filler cap from the aircraft. (nozzle operator)

WARNING

Always bond the nozzle to the aircraft before the fill cap is removed. This connection shall remain in place until the entire fueling operation is complete. Failure to bond nozzle and/or maintain contact can result in a dangerous static spark inside the fuel tank.

10. Insert overwing nozzle into the aircraft's refueling port and maintain metal-to-metal contact between the overwing nozzle and the aircraft's refueling port throughout the entire fueling operation. (nozzle operator)
11. Upon receiving signals from nozzle operator/plane captain that hook-up has been completed and they are ready to begin fueling operation, station operator actuates the remote, hand-held, deadman control.



**WARNING**

Deadman controls are not to be blocked open or otherwise inhibited, as this will defeat the purpose of the device and can lead to a catastrophic accident.

12. Nozzle operator shall squeeze the handle on the overwing nozzle to initiate fuel flow and fuel aircraft as directed by plane captain. Plane captain shall monitor aircraft vents, tank pressure gauge(s), and/or warning lights as necessary.
13. When directed by the plane captain, release deadman control. (station operator)
14. Disconnect nozzle bonding wire from the aircraft. (nozzle operator)
15. Stow the pantograph or hose. (nozzle operator and station operator)
16. Complete paperwork. (nozzle and station operators)

12.4 TRUCK OPERATIONS

12.4.1 Truck Fill Stands

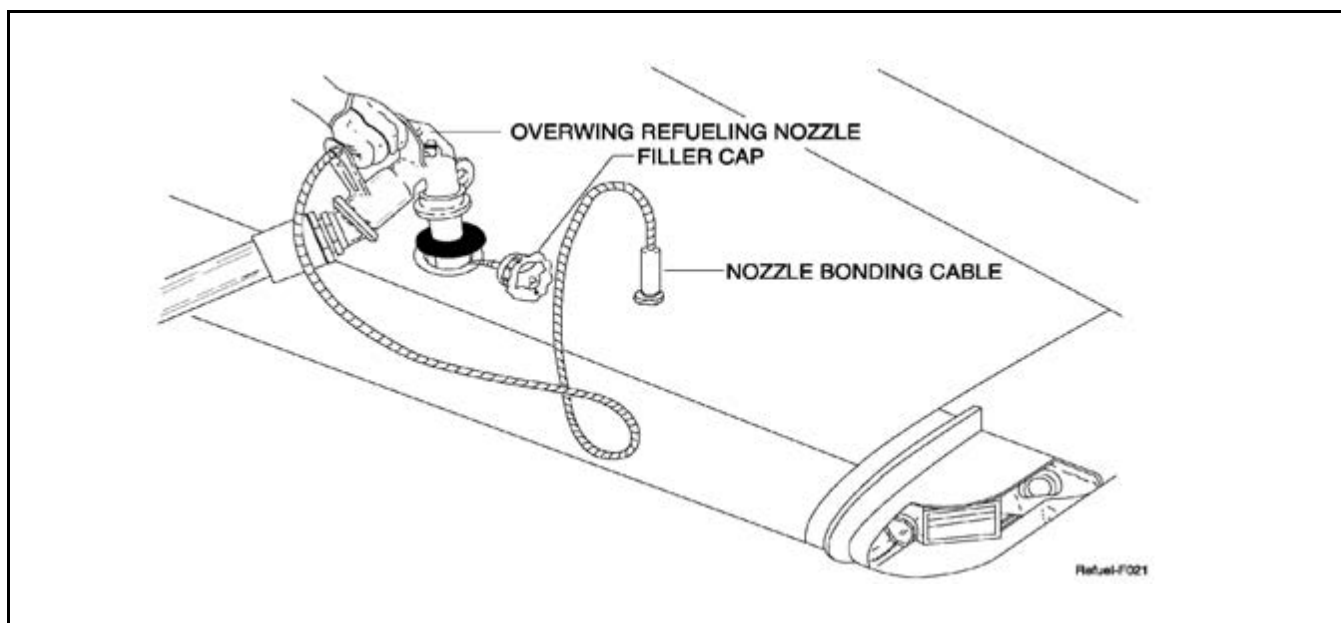
12.4.1.1 Personnel Requirements

The operation of truck fill stands is a one-person operation for trucks equipped with high-level alarms/shut-off and deadman control valves at the fill stand. This is a two-man operation for equipment not having these devices.

WARNING

- Top loading shall not be performed. This method of filling tanks is extremely dangerous because of the highly flammable vapors and static charges produced.
- Personnel shall not be on top of the truck during the filling operation.

Figure 12-4. Electrical Bonding of Overwing Refueling Nozzle to Aircraft





12.4.1.2 Procedures

Trucks shall be filled in the following sequence:

1. Position truck, turn off lights, place gear shift in neutral/park position, set parking brake, stop engine, and turn off all switches (except for necessary alarms, etc.).
2. Verify product and estimate the amount of product to be loaded.
3. Connect bond or high-level control cable.
4. Connect delivery nozzle to truck's bottom loader.
5. Set meter and enter necessary information on truck fill order or other form.
6. Start filling operation slowly.



Trucks that have been completely drained shall be minimally filled (500 to 1,000 gallons) at a low flow rate in order to cover the bottom inlet valve inside the truck's tank.

7. After tank is filled, secure pump unless it has secured automatically.
8. Disconnect nozzle.
9. Disconnect bond or Scultrol jumper cable.
10. Complete paperwork.
11. Inspect truck for leaks.
12. Remove refueler to truck parking area.

12.4.2 Cold Refueling Aircraft with Trucks

Each activity shall record the movements and operations of its trucks with a log similar to [Figure 12-5](#).



Page #:

[illegible]

Prothrombin F0222



12.4.2.1 Positioning of Refueler

Positioning of refuelers to service aircraft shall be performed in the same manner without variation so all personnel involved know exactly what to expect. Whenever possible, refuelers shall proceed down a line of parked aircraft with the driving path perpendicular to the aircraft fuselage axis, at the maximum distance hose length will permit servicing; however, at no time shall a truck approach closer than 10 feet of an aircraft. This normal refueler approach path, which is illustrated in [Figure 12-6](#), is applicable to all fixed-wing tactical aircraft and helicopters. Normally no turns are made except at the end of the parking line. Driving between aircraft parked in line shall be avoided; however the preferred approach is not always possible. [Figure 12-7](#) shows acceptable alternate methods when aircraft are not parked in line or hose lengths are insufficient for service. [Figure 12-8](#) shows the safe approach paths to prop, prop/jet, and transport aircraft, while [Figure 12-9](#) illustrates the alternate approach paths for helicopters.

Refuelers shall never:

1. Be left pointing toward any part of an aircraft.
2. Be driven in the area described by straight line projections connecting points 10 feet from an aircraft's extremities. (See [Figures 12-7](#), [12-8](#), and [12-9](#).)
3. Be backed in the proximity of aircraft without the use of a spotter and a wheel chock pre-positioned at the point where the refueler must stop.
4. Be positioned closer than 10 feet from any part of the aircraft.

The refueler shall be parked in a position on the same side of the aircraft as the aircraft's adapter so that the driver/operator has a direct line of sight to the refueling nozzle operator while actuating the deadman control. The refueling hose shall not pass underneath or around the aircraft to reach the refueling receptacle.

WARNING

- Failure of the driver/operator to visually observe the nozzle operator throughout the refueling operation can lead to a fuel spill and fire.
- Never operate both overwing and pressure fueling systems at the same time. Excessive pressure surges may occur on the overwing nozzle.

Note

Vehicle tailpipe temperature and the location of aircraft tank vents are important considerations when determining alternate routes and fueling positions.





Figure 12-6. Normal Refueler Approach Path and Refueling Safety Zone

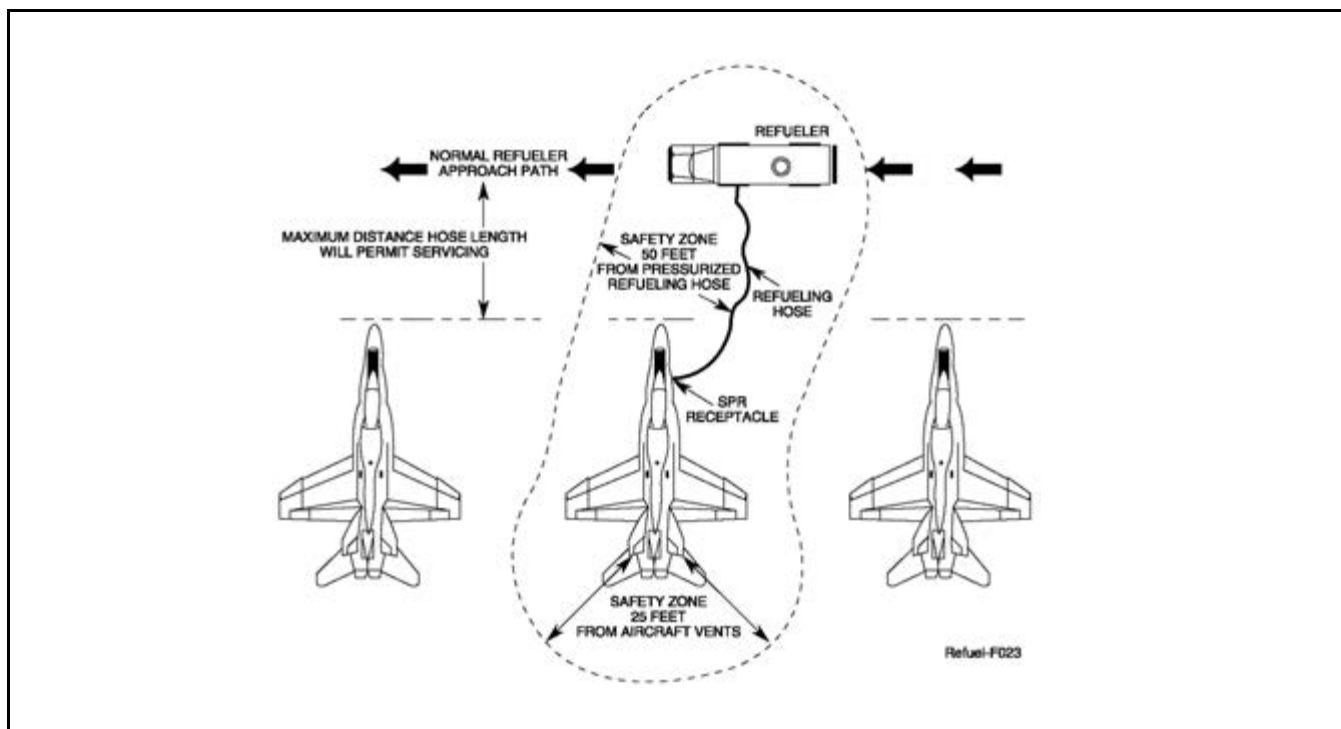


Figure 12-7. Alternate Refueler Approach Paths

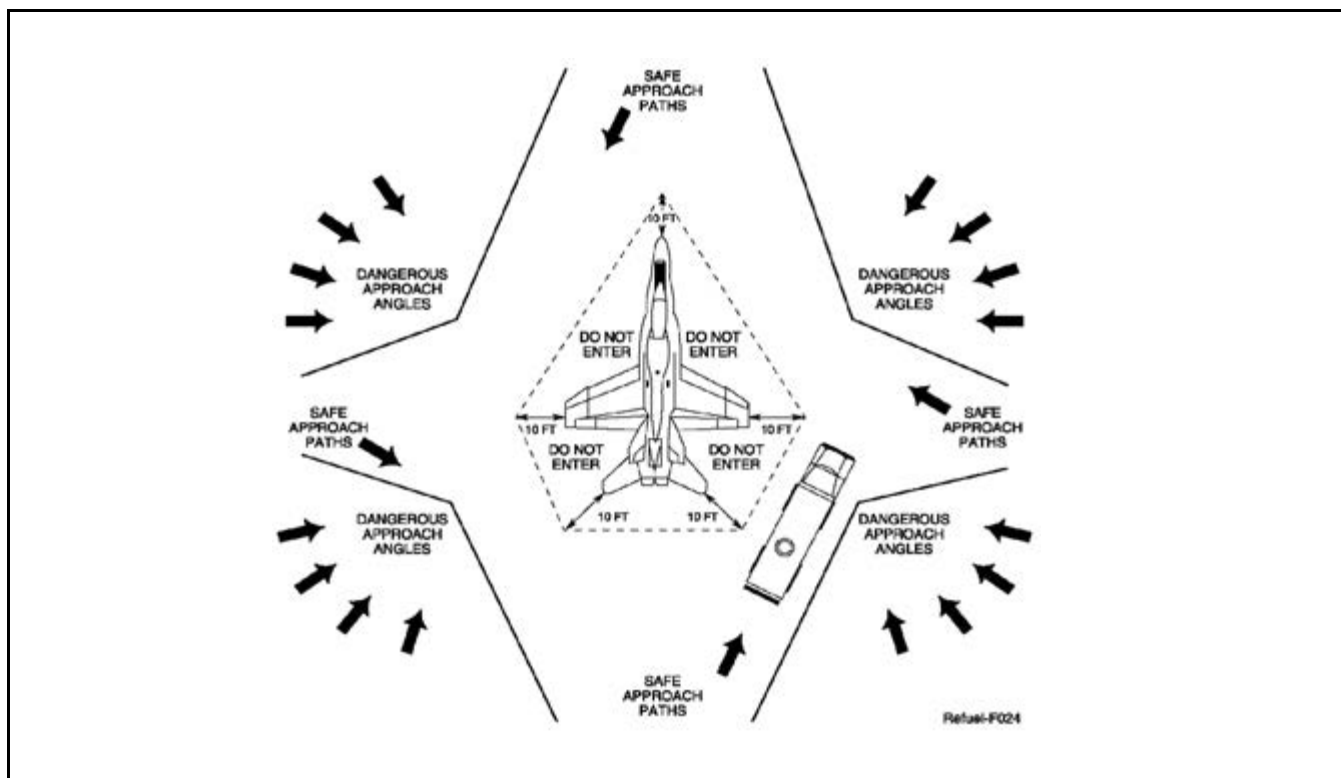




Figure 12-8. Refueler Approach to Prop, Prop/Jet, and Transport Aircraft

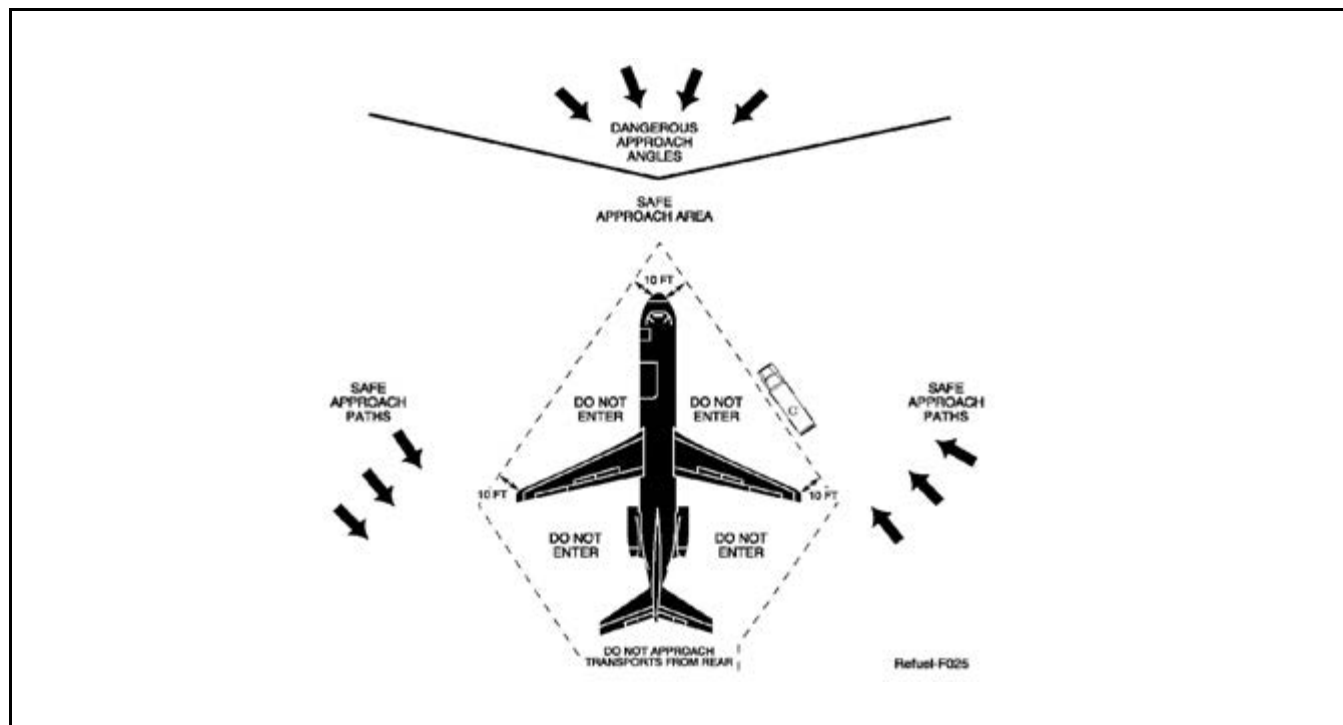
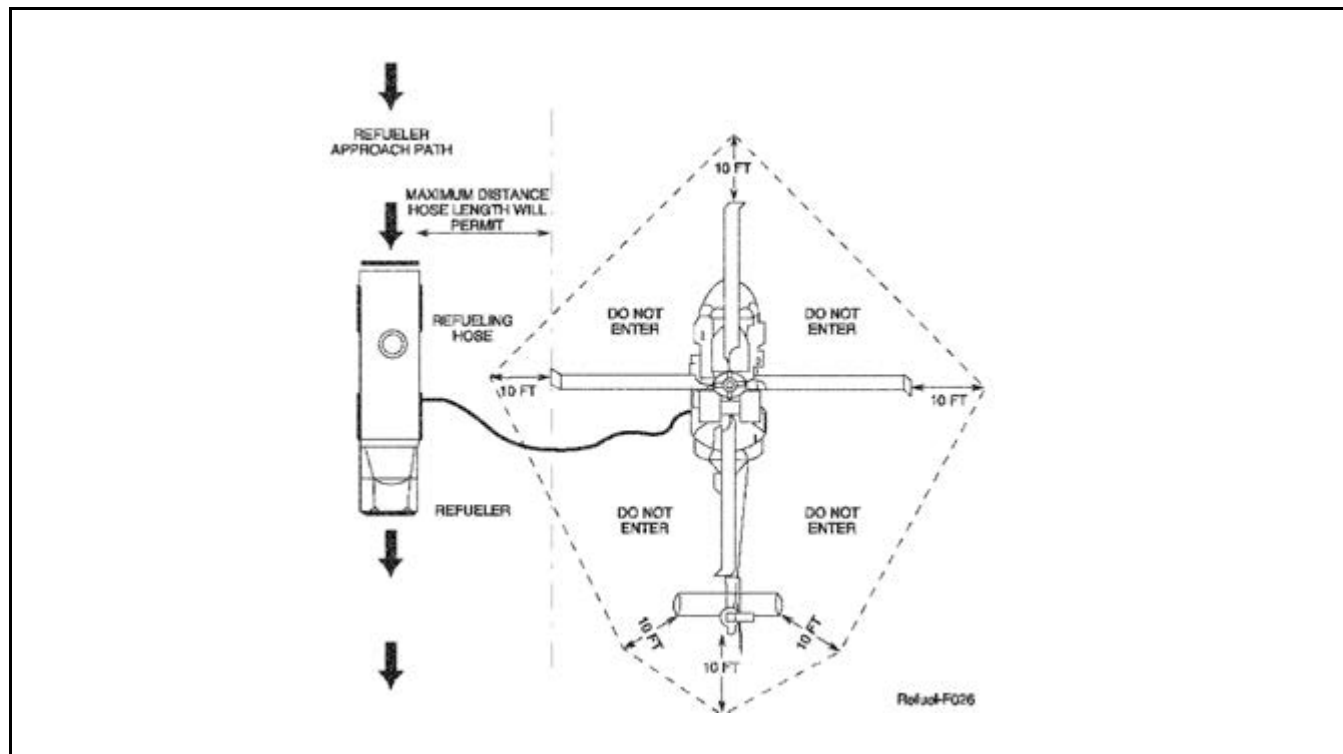


Figure 12-9. Alternate Refueler Approach to a Helicopter





12.4.2.2 Truck Preparation Procedures

Prepare truck for refueling operations as follows:

1. Recirculate/Flush the truck and take fuel sample for quality control checks as appropriate. (refueler operator)

WARNING

Fuel shall be recirculated/flushed through refueling hose and nozzle, and tested for contamination prior to refueling the first aircraft each day. Fueling shall not begin until acceptable results have been obtained (i.e., clear and bright with no visible sediment/particulates) (see [Chapter 9](#)). Failure to provide clean, dry fuel to the aircraft can adversely affect safety-of-flight.

Note

Flushing the overwing nozzle requires a special receiving port that is piped to fuel storage. An alternate approach is to recirculate the refueling station and take samples with the SPR nozzle in place, then replace the SPR with overwing nozzle immediately before commencing refueling operations.

2. Drive refueler into position for refueling following approach paths discussed above. Refueler shall be positioned so that it can be driven away quickly in an emergency. No wheel chocks shall be used.
3. Set brakes.
4. Place gear shift in neutral.
5. Turn off headlights and unnecessary switches. (driver/operator)
6. The driver's side door shall remain open during the entire refueling operation.

12.4.2.3 Truck Pressure Refueling

12.4.2.3.1 Personnel Requirements

Cold refueling aircraft with JP-5, JP-8, F-24, or commercial Jet A or Jet A-1 via trucks is a two-person function requiring a nozzle operator and a driver/operator. In an emergency the driver/operator's first duties will be to release the deadman control and then operate the fire extinguisher while the nozzle operator disconnects the nozzle from the aircraft. The nozzle operator shall then take over responsibility for the fire extinguisher while the driver/operator reels in the hose and removes the truck from the area. Under normal conditions the nozzle operator shall assist the driver/operator in removing and replacing the hose on the refueler in order to minimize wear and damage to the hose and refueling nozzle.

CAUTION

Cold refueling aircraft with JP-4 or commercial JET B is a three-man operation requiring a dedicated fire extinguisher operator in addition to the two personnel discussed above.

12.4.2.3.2 Procedures

When truck is in position and prepared as above, conduct fueling operations as follows:



**WARNING**

Hot brake check shall be performed prior to positioning of the refueler.

Note

Hot brake check is applicable to fixed-wing aircraft, or as required.

1. Secure all electronic and electrical switches on the aircraft not required for fueling. (plane captain)
2. Verify the fire extinguisher is at the refueling point. (station operator)
3. Attach bonding cable between the refueling equipment and the aircraft. See [Figure 12-10](#). (plane captain)

Once a fueling evolution has commenced, the aircraft's electrical power status and connections shall not be changed until evolution has been completed or refueling has been stopped for an emergency (e.g., no aircraft engines or APU shall be started or stopped and external power shall not be connected, disconnected, or switched on/off).

WARNING

Changing the aircraft's electrical power status can create significant ignition sources.

Note

Switching off the F-35 28V battery does not provide a hazardous ignition source and is an acceptable procedure during refueling.

4. Aircraft carrying ordnance shall be cold refueled only in areas authorized by local SOPs. Prior to refueling aircraft carrying ordnance, certified and qualified personnel shall verify all ordnance is safed. Safed is defined as the replacement of any mechanical arming lever, safety pin, electrical interrupt plug/pin, securing of armament switches, and/or any appropriate action that renders the particular ordnance carried as safe.

WARNING

- Refueling of aircraft with hung ordnance of any type is prohibited.
 - In case of fuel or ordnance incident all operations shall cease until deemed safe.
5. Pull out the hose (or pantograph) and place in proper position for refueling. (nozzle operator and refueler operator)
 6. Remove refueling adapter cap from the aircraft and the dust cover from the SPR nozzle. Inspect the face of the nozzle to make sure it is clean and verify the flow control handle is in the fully closed and locked position. (nozzle operator)
 7. Visually inspect the aircraft's adapter (receptacle) for any damage or significant wear. If any doubt about the integrity of the adapter exists, use the go/no-go gauge (NSN 5220-01-301-9247) or alternate go/no-go gauges (NSN 5220-01-343-1688, 5220-01-554-2538) to determine acceptability. (Plane captain/aircrew)



**WARNING**

A worn or broken adapter can defeat the safety interlocks of the refueling nozzle permitting the poppet valve to be in the open position when removed from the SPR adapter and fuel to spray or spill.

8. Lift nozzle by lifting handles, align the lugs on the nozzle with the slots on the aircraft adapter, and hook up the nozzle to the aircraft by pressing it firmly onto the adapter and rotating it clockwise to a positive stop. (nozzle operator)

WARNING

Nozzle must seat firmly on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system, which can lead to a fuel spray or spill.

Note

Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. A defective or worn aircraft SPR can also be detected in this manner.

9. Zero the refueling meter or note the truck's totalizer reading. (refueler operator)
10. Rotate the nozzle flow control handle to the FULL OPEN position. The handle shall rotate 180 degrees to ensure the poppet valve is fully open and locked. (nozzle operator)

WARNING

The flow control handle of the single point pressure refueling nozzle shall be placed in either of two locked positions — fully open or fully closed. The handle is not to be used as a flag to indicate fuel flow. Excessive wear on the aircraft adapter and the fuel nozzle poppet will result if the handle is allowed to “float” in the unlocked position.

11. Upon receiving signals from nozzle operator/plane captain that hook-up has been completed and they are ready to begin fueling operation, refueler operator actuates the remote, hand-held, deadman control.

WARNING

Deadman controls are not to be blocked open or otherwise inhibited, as this will defeat the purpose of the device and can lead to a catastrophic accident.

12. Once fuel flow has been established, exercise the aircraft's precheck system. (plane captain)



**Note**

- The precheck system simulates the completion of refueling by closing all of the tank shut-off valves within the aircraft. All fuel flow into the aircraft should stop within a few seconds to 1 minute of actuating the precheck system. On aircraft equipped with a fuel indicator, the primary means of detecting successful precheck is by observing the flow indicator on the aircraft to make sure that it stops. If the aircraft is not configured with a flow indicator, or if the aircraft flow indicator is inoperative, the only acceptable means of determining that precheck has been successful is to watch the fuel delivery system's flow counter (flow meter) to ensure it stops. A stiffening (or jerking) of the refueling hose or indication of a fueling pressure spike is not a suitable indication that precheck has successfully occurred (hose stiffening/jerking and pressure spikes can occur whenever one or more aircraft fuel tank refueling valves close).
 - Aircraft may be cold refueled if it fails precheck, but special procedures are required. See appropriate aircraft NATOPS Manual. This should be done only if it is an operational necessity.
13. Fuel aircraft as directed by plane captain. Plane captain shall monitor aircraft vents, tank pressure gauge(s), and/or warning lights as necessary.
 14. When directed by the plane captain, release deadman control. (refueler operator)
 15. Rotate the nozzle flow control handle into the OFF and fully locked position. (nozzle operator and verified by the refueler operator)

WARNING

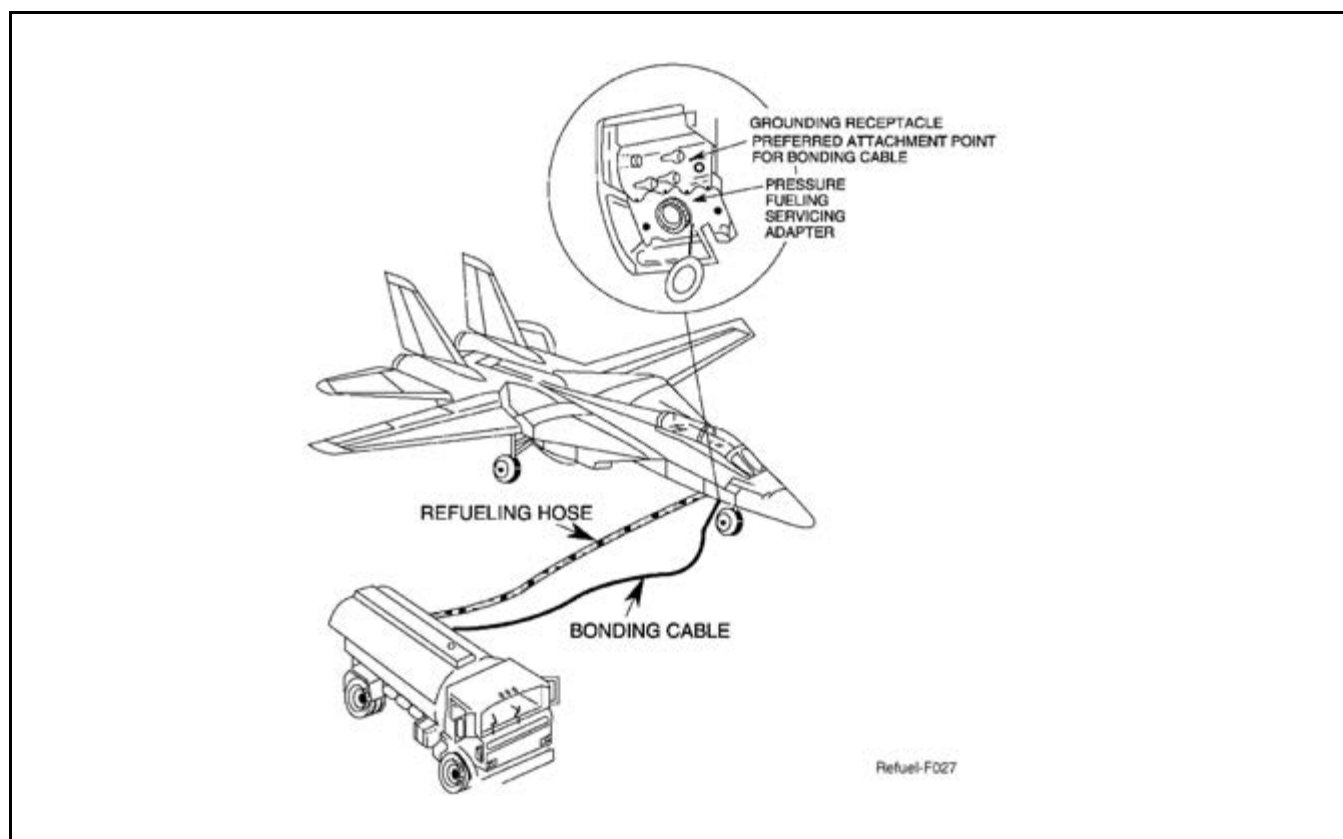
Failure to lock the flow control handle in the OFF position can contribute to a failure of the nozzle's safety interlock system and, ultimately, a fuel spray or spill.

16. Disconnect nozzle from the aircraft adapter. (nozzle operator)
17. Stow the pantograph or hose. (nozzle operator and refueler operator)
18. Complete paperwork. (nozzle and refueler operators)





Figure 12-10. Electrical Bonding of Aircraft and Truck (Cold Refueling)



12.4.2.4 Truck Overwing Refueling

12.4.2.4.1 Personnel Requirements

Overwing refueling via truck is a three-person operation requiring a nozzle operator, a driver/operator, and a fire extinguisher operator.

12.4.2.4.2 Procedures

Once the refuel truck is in position and prepared as stated in [paragraphs 12.4.2.1](#) and [12.4.2.2](#), conduct fueling operations as follows:

WARNING

Hot brake check shall be performed prior to positioning of the refueler.

Note

Hot brake check is applicable to fixed-wing aircraft, or as required.

1. Secure all electronic and electrical switches on the aircraft not required for fueling. (plane captain)
2. Verify the fire extinguisher is at the refueling point. (station operator)
3. Attach bonding cable between the refueling equipment and the aircraft. (See [Figure 12-10](#).) (plane captain)

Once a fueling evolution has commenced, the aircraft's electrical power status and connections shall not be changed until evolution has been completed or refueling has been stopped for an emergency (e.g., no





aircraft engines or APU shall be started or stopped and external power shall not be connected, disconnected, or switched on/off).

WARNING

Changing the aircraft's electrical power status can create significant ignition sources.

Note

Switching off the F-35 28V battery does not provide a hazardous ignition source and is an acceptable procedure during refueling.

4. Aircraft carrying ordnance shall be cold refueled only in areas authorized by local SOPs. Prior to refueling aircraft carrying ordnance, certified and qualified personnel shall verify all ordnance is safed. Safed is defined as the replacement of any mechanical arming lever, safety pin, electrical interrupt plug/pin, securing of armament switches, and/or any appropriate action that renders the particular ordnance carried as safe.
5. Zero the refueling station's meter or note the station's totalizer reading. (refueler operator)
6. Pull out the hose and place in proper position for refueling. (nozzle operator and refueler operator)
7. Bond the overwing nozzle to the aircraft as shown in [Figure 12-4](#) and then remove the filler cap from the aircraft. (nozzle operator)

WARNING

Always bond the nozzle to the aircraft before the filler cap is removed. This connection shall remain in place until the entire fueling operation is complete. Failure to bond nozzle and/or to maintain contact can result in a dangerous static spark inside the fuel tank.

8. Insert overwing nozzle into aircraft's refueling port and maintain metal-to-metal contact between the overwing nozzle and the aircraft's refueling port throughout the entire fueling operation. (nozzle operator)
9. Upon receiving signals from nozzle operator/plane captain that hook-up has been completed and the fueling operation is ready to begin, refueler operator actuates the remote, hand-held, deadman control.

WARNING

Deadman controls are not to be blocked open or otherwise inhibited, as this will defeat the purpose of the device and can lead to a catastrophic accident.

10. Nozzle operator shall slowly squeeze the handle on the overwing nozzle to initiate fuel flow and fuel aircraft as directed by plane captain. Plane captain shall monitor aircraft vents.
11. When directed by the plane captain, release deadman control. (station operator)
12. Disconnect nozzle bonding wire from the aircraft. (nozzle operator)
13. Stow the hose. (nozzle operator and station operator)
14. Complete paperwork. (nozzle and station operators)





12.4.3 Refueler Parking

All activities shall require that refueling vehicles be constantly attended whenever the engine is operating. Operator is considered in attendance when performing tasks directly associated with fueling an aircraft (e.g., assisting aircraft refueling operator, transporting hose, etc.). If for any reason the operator leaves his/her truck unattended, he/she shall first:

1. Drive truck clear of aircraft.
2. Place air brake in ON and LOCKED position, if applicable.
3. Set parking brakes.
4. Direct front wheels to an open unobstructed area.
5. Stop engine.
6. Chock the drive wheels.

12.5 FUELING WITH ENGINES OPERATING (HOT REFUELING)

Hot refueling shall be performed only when operational requirements dictate since this operation is significantly more dangerous and costly — both in terms of fuel and manpower expenditures. Pressure hot refueling only shall be performed.

12.5.1 Personnel Requirements

A minimum of three groundcrew personnel are required for each hot refueling operation. All personnel performing hot refueling operations shall be fully trained and qualified in accordance with [Chapter 8](#) and local instructions. The duties of each of these personnel are listed in the following paragraphs.

WARNING

If the station is configured such that the deadman control operator does not have a direct line-of-sight of both the aircraft pilot and the nozzle operator, a fourth person (refueling coordinator) is mandatory.

1. One station operator. Duties include actual operation of the deadman control.
2. One nozzle operator. Duties include the performance of necessary aircraft refueling checks such as exercising of the shutoff valves precheck system and vent and refueling panel monitoring. The nozzle operator shall remain at the nozzle throughout the refueling and leave only to conduct necessary vent checks.
3. One fire watch. Duty is to man the fire extinguisher throughout the entire refueling operation.
4. One refueling coordinator (plane captain). Duties include directing all movements of the aircraft and coordinating hand signals between fuel crew and pilot.

Note

When the deadman control operator has direct line-of-sight of both the aircraft pilot and the nozzle operator, the refueling coordinator's duties may be performed by the nozzle operator.

12.5.2 Equipment Requirements

The following equipment is the absolute minimum required to conduct hot refueling operations at shore activities.

1. One fuel service unit, such as a direct refueling station, mobile refueler, hose cart, TAFDS, and HERS. This unit shall possess all of the required features and systems listed in [Chapter 11](#) for systems/facilities





that refuel aircraft (e.g., filter/separator). This fuel servicing unit shall be grounded (earthed) through a connection that offers less than 10,000 ohms resistance. The servicing system's fuel supply tank(s) shall be located at least 50 feet from any part of the aircraft (wings, rotor blades, etc.) being serviced.

WARNING

The fuel service unit shall have a completely operational deadman control. The deadman control shall cut off the flow of fuel to the aircraft immediately (within 2 seconds) upon release. Leakage past this valve with the deadman in the released position shall not exceed 1 gallon in 5 minutes.

2. A fixed or portable pantograph system; an approved tactical refueling system (TAFDS, HERS, ABFC-H14K); or a mobile refueler.

Note

For safety purposes, it is highly recommended that hot refueling from mobile refuelers be conducted by the use of mobile pantographs. When mobile pantographs are not available, hot refueling from mobile refuelers shall be conducted using mobile refuelers that meet the following requirements:

- All requirements of [paragraph 11.3.2](#) to include the installation of an approved emergency dry breakaway coupling.
 - Are outfitted with enough refueling hose to ensure the mobile refueler's fuel tank shall remain a minimum of 50 feet away from the nearest part of the aircraft being serviced.
3. One bonding/grounding cable. New direct refueling stations are designed with the bonding/grounding cable built into the pantograph and along the hose. A separate bonding cable is therefore not needed with these systems. If a continuity check proves the resistance to be 10,000 ohms or less, the requirement for continuity is satisfied.

WARNING

Both the system (truck) and aircraft must be grounded to the earth as well as bonded to each other when conducting hot refueling operations with trucks.

4. Aircraft wheel chocks or similar restraining device.
5. Sound-attenuating ear protectors, goggles, cranials, long-sleeved shirts, and pants for each crewmember. Personnel shall not wear shoes that have nails or other metal devices on the soles that might cause sparking.
6. A fire extinguisher for each aircraft being refueled (see NATOPS Aircraft Firefighting and Rescue Manual, NAVAIR 00-80R-14).

WARNING

All ground personnel involved in the hot refueling operation shall be qualified in the operation of the fire extinguishing equipment in use.

7. One emergency dry-breakaway coupling. This device shall be attached to the refueling hose near the pantograph (on direct refueling stations) or attachment point to the fuel servicing unit.





12.5.3 Hot Refueling Procedures

12.5.3.1 Initial Hot Refueling Procedures Prior to Entering the Refueling Area

The following steps shall be accomplished prior to the aircraft entering the hot refueling area:

WARNING

Prior to the arrival of aircraft, ensure refueling equipment is positioned in the designated hot refueling area, is manned, and is ready for use.

1. Check for hot brake condition.

WARNING

Hot refueling shall not be performed if a hot brake condition exists.

Note

- Hot brake check is applicable to fixed-wing aircraft, or as required.
 - Hot brake checks are not required for AV-8B aircraft conducting Field Carrier Landing Practices.
2. Recirculate/Flush the station or mobile refueler and take fuel sample for quality control checks as appropriate. (station operator)

WARNING

- Fuel shall be recirculated/flushed through refueling hose and nozzle and tested for contamination prior to refueling the first aircraft each day. Fueling shall not begin until acceptable results have been obtained (e.g., clear and bright with no visible sediment/particulates [see [Chapter 9](#)]). Failure to provide clean, dry fuel to the aircraft can adversely affect safety-of-flight.
 - No nozzle samples shall be taken after the aircraft has taxied into the designated hot refueling area/direct fueling station. Sampling increases the possibility of a fuel spill.
3. The area shall be policed for FOD.
 4. Groundcrew shall wear equipment and clothing described in [paragraph 12.5.2, step 5](#).
 5. Certified and qualified personnel shall verify all ordnance is safed. Safed is defined as the replacement of any mechanical arming lever, safety pin, electrical interrupt plug/pin, securing of armament switches, and/or any appropriate action that renders the particular ordnance carried as safe.
 6. Hot refueling of aircraft with hung ordnance of any type is prohibited.
 7. Simultaneous fueling, loading, and downloading of weapons to include preloaded IMERS/ITERS and "PASE" weapons and installation of fuses and arming wires is authorized with the following restrictions adhered to:
 - a. Loading/downloading and oxygen converter replacement can be done simultaneously, all other oxygen serving shall be conducted as separate evolutions.





- b. Refueling hoses shall not be connected to an aircraft which is undergoing the Loading/Downloading of ordnance requiring electrical connections to the aircraft weapons system (i.e., installation/removal of umbilical cables, mating/unmating of the buffer connector/wafers and rocket motor firing contacts).
 - c. No electrical connections to weapons or installation of impulse cartridge(s) shall be accomplished while fueling of that aircraft is in progress.
 - d. Fuel hoses shall not be positioned under weapons being loaded/ downloaded.
 - e. When lightning is observed within a 10-mile radius of the installation, all ordnance handling shall cease; ordnance should be made as safe as practical and personnel should seek cover. Aircraft already loaded not requiring arming procedures may taxi and launch at the discretion of unit commanding officers and pilots in command as modified by other applicable instructions. Aircraft already loaded with ordnance requiring arming shall not be armed during periods when lightning is observed within 10 miles. Aircraft landing during the above conditions requiring dearming shall remain in the dearming area until the lightning threat passes.
8. Hot refueling of explosive loaded combat aircraft is prohibited except for FARP and FOB operations specified in NAVAIR 00-80T-109 and NAVAIR 00-80T-115. Dummy ordnance, practice ordnance containing only flash or impact signal cartridges, training missiles without live warheads and motors, internally carried pyrotechnics and SUS charges, aircraft peculiar cartridge actuated devices, de-armed internally mounted guns loaded with target practice ammunition, and USMC aircraft loaded with sympathetically initiated decoy flares and chaff operating on Marine Corps Air Stations are excluded from this requirement.
9. For USMC Aircraft operating aboard other DOD Bases or Stations where hot refueling with decoy flares loaded is authorized, signature approval for hot refueling operations with decoy flares must be obtained from the local Base or Station Commanding Officer prior to conducting such operations. All host Station procedures, and requirements, in addition to the procedures listed in [paragraph 12.5.3.2](#) must be understood and strictly adhered to. US Navy aircraft loaded with chaff are prohibited from hot refueling.

12.5.3.2 Hot Refueling of USMC Aircraft Loaded With Decoy Flares

WARNING

- Hot refueling of aircraft with hung ordnance of any type is prohibited.
 - Explosive-loaded combat aircraft are not permitted in fuel pits except when specifically authorized by NAVAIR 00-80T-109 for FARP and FOB operations.
 - USMC UC-35 aircraft are not authorized for hot refueling with decoy flares due to insufficient safety features except when specifically authorized by NAVAIR 00-80T-109 for FARP and FOB operations.
 - Aircraft de-arming and re-arming shall be carried out in designated areas prior to entry and after departure from the refueling pits.
 - MJU-8/B, MJU-8A/B, MK-46, M206, M211, M212, MJU-46/B, and MJU-50/B decoy flares are not authorized for hot refueling operations.
1. All fuel, ordnance and aircrew performing hot refueling of USMC aircraft with loaded decoy flares must review applicable hot refueling procedures with decoy flares. Safety briefs for ordnance and fuel personnel are required and must be conducted by the respective team leaders at the beginning of each shift if hot refueling with decoy flares is planned. Individual safety, firefighting equipment, emergency procedures and team assignments should be covered during each brief.
 2. Hot pit refueling of USMC aircraft with loaded decoy flares shall only be conducted by qualified fuel personnel in accordance with NA 00-80T-109.





3. Safing/de-arming and inspection procedures shall only be performed by qualified personnel for specific type/model USMC aircraft and shall be safed and physically inspected per appropriate ECM checklist. Aircraft determined to have unsafe or suspect payloads shall be denied access to the fuel pit area.
4. Only MJU-32/B, MJU-32A/B, MJU-38/B, MJU-38A/B, MJU-27A/B, MJU-49/B, SM-875/ALE SIM FLARE, SM-875A/ALE SIMFLARE, SM-875B/ALE SIMFLARE, MJU-55/B, MJU-57/B, MJU-57A/B, MJU-61/B, MJU-61A/B, MJU-64/B, and MJU-66/B sympathetically initiated decoy flares and all types of Chaff RR-129, RR-144, RR-170A/AL, and RR-188/AL are authorized for USMC hot refueling operations. All flares and chaff listed above shall utilize a HERO safe impulse cartridge.
5. Only CCU-136A/A and CCU-145/A Cartridge Actuated Devices (CADS) are authorized to be installed in ECM systems during USMC aircraft hot refueling.
6. Certified grounding points and aircraft grounding reels shall be utilized during hot refueling with decoy flares loaded. All grounding requirements established in MIL-HDBK-274 and NA00-80T-109 will be adhered to.
7. First response firefighting capability at individual hot pit fueling points shall consist of a 30 pound PKP fire extinguisher with an additional 150 pound Halon fire extinguisher for every two fueling points when hot fueling USMC aircraft with loaded decoy flares.

12.5.3.3 Hot Refueling Procedures in the Refueling Area

WARNING

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

Once the aircraft has been determined ready for entry into the hot refueling area, the following steps shall be performed:

1. The aircraft shall be taxied into the hot refueling area in accordance with local SOPs. The aircraft shall enter the area with the refueling receptacle on the side of the aircraft nearest the pantograph or hose. Once properly positioned, the aircraft shall be chocked.

The following prohibitions shall be observed:

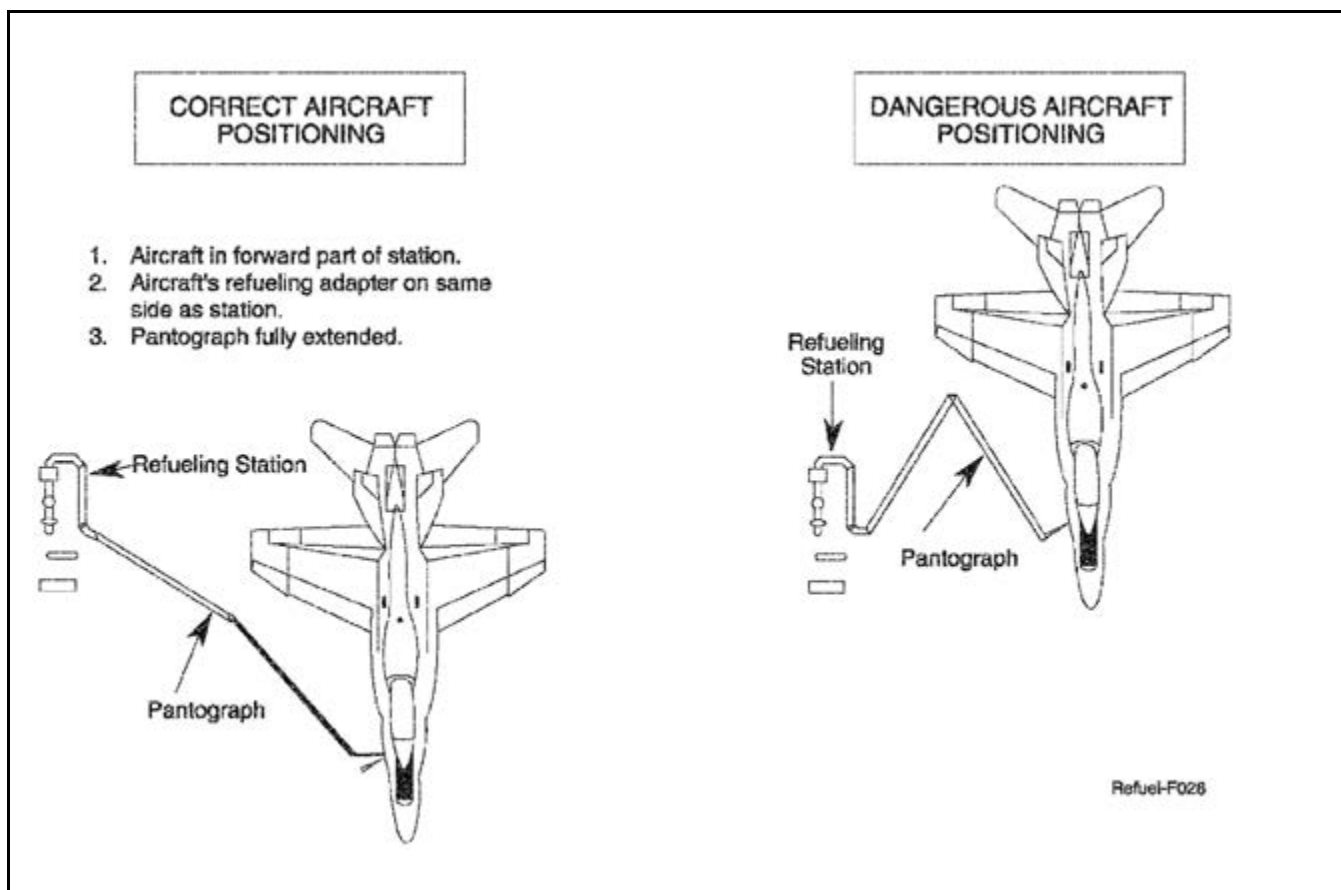
- a. Servicing the AV-8B's water injection system/tank is not authorized in the refueling area.
- b. Pantograph must be extended to a sufficient distance for the emergency dry breakaway coupling to work properly without the pantograph interfering with movement of the aircraft (see [Figure 12-11](#)).
- c. The refueling hose or pantograph shall not pass underneath or around the aircraft to reach the refueling receptacle. This will interfere with the operation of the emergency dry breakaway coupling or may result in the severing of the hose/pantograph in the event of a malfunction or failure of the aircraft's landing gear.
- d. Crew changes and hot seating shall not be conducted in the fuel pits while refueling hoses are attached to the aircraft.
- e. Discontinue refueling immediately if any leaks or spills occur during the refueling operation.
- f. The deadman control operator shall have a direct line-of-sight to the refueling nozzle operator at the aircraft receptacle whenever he/she is actuating the deadman control.
- g. The engine with the propeller or intake nearest the aircraft fueling receptacle shall be secured. Deviations are permitted only when specific aircraft NATOPS states to leave both engines running.





- h. Aircraft canopy and helicopter side doors (if installed) shall remain closed during the entire refueling evolution. Aircraft refueling operations shall be secured if canopy is opened. The following are exceptions to this rule:
- (1) Rear cargo doors and/or doors on opposite side of aircraft from the refueling adapter may be open, provided the refueling hose is positioned so that it is unlikely fuel sprays from nozzle/adapter malfunction or hose rupture will enter aircraft passenger/cargo/cockpit compartment(s).
 - (2) The AV-8B aircraft may be hot refueled with the canopy open at the pilot's discretion when high temperatures and humidity dictate since the aircraft's environmental control system does not operate with weight on wheels.
 - (3) The MH-60S helicopter may be hot refueled with the 20mm Gun System installed without the environmental barrier provided the left cabin door is held against the feed chute and the refueling hose is positioned so that it is unlikely fuel sprays from nozzle/adapter malfunction or hose rupture will enter cabin and/or cockpit compartment(s).
2. Pilot shall secure all unnecessary electronic and electrical equipment not required for refueling.
 3. Verify manned firefighting equipment is properly positioned to the refueling operation. (station operator)

Figure 12-11. Positioning of Aircraft for Pantograph Refueling





4. Bond the aircraft to the refueling equipment and ground the aircraft to an earth ground with a resistance to ground value of 10,000 ohm or less. (plane captain)

Note

- Unlike cold refueling systems, aircraft with engines or APU running generate additional static electricity that must be bled to ground.
 - In direct fueling systems, both bonding and grounding are normally accomplished simultaneously with the attachment of the refueling nozzle to the aircraft. The nozzle/hose/pantograph system provides a continuous electrical path between the aircraft and the fueling equipment that is grounded to Earth. (See [Figure 12-3](#).)
 - If bonding and grounding are not established in the direct fueling station through the nozzle/hose/pantograph system, a separate cable that is both bonded to the fueling equipment and grounded to a 10,000 ohms or less earth ground must be provided. The grounding receptacle near the aircraft's refueling adapter should be used; if this is not possible, connection should be made to bare metal on the aircraft.
 - When hot refueling from refueling trucks, the truck shall be connected to an Earth ground of 10,000 ohms or less, and the truck and the aircraft shall be bonded to each other. If a portable or permanently anchored pantograph has been properly earthed and configured there is electrical continuity between the nozzle and the pantograph. The truck's bonding cable shall be attached to this pantograph.
 - Primary aircraft taxi directors shall be aircraft crewchiefs, plane captains, trained and qualified squadron personnel, or visiting aircraft line personnel when hot refueling aircraft at fixed facilities.
5. Pull out the pantograph (or reel out hose) and place in proper position for refueling. (nozzle operator and station operator)
 6. Remove refueling adapter cap from the aircraft and the dust cover from the SPR nozzle. Inspect the face of the nozzle to ensure it is clean and verify the flow control handle is in the fully closed and locked position. (nozzle operator)
 7. (Plane captain/aircrew) Visually inspect the aircraft's adapter (receptacle) for any damage or significant wear. If any doubt about the integrity of the adapter exists, use the adapter go/no-go gauge (NSN 5220-01-301-9247) or alternate go/no-go gauge (NSN 5220-01-343-1688, 5220-01-554-2538) to determine acceptability.

WARNING

A worn or broken adapter can defeat the safety interlocks of the refueling nozzle permitting the poppet valve to be in the open position when removed from the SPR adapter and fuel to spray or spill.

8. Lift nozzle by lifting handles, align the lugs with the slots on the aircraft adapter and hook up to the aircraft by pressing firmly onto the adapter and rotating it clockwise to a positive stop. (nozzle operator)



**WARNING**

The nozzle must be seated firmly on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system, which can lead to a fuel spray or spill.

Note

Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. A defective or worn aircraft SPR can also be detected in this manner.

9. Zero the refueling meter or note the totalizer reading.
10. Upon receiving signals from the nozzle operator/plane captain that hook-up has been completed and the fueling operation is ready to begin, station operator actuates the remote, hand-held, deadman control.

Once a fueling evolution has commenced, the aircraft's electrical power status and connections shall not be changed until evolution has been completed or refueling has been stopped for an emergency (e.g., no aircraft engines or APU shall be started or stopped and external power shall not be connected, disconnected, or switched on/off).

WARNING

- Changing the aircraft's electrical power status can create significant ignition sources.
- Deadman controls are not to be blocked open or otherwise inhibited, as this will defeat the purpose of the device and can lead to a catastrophic accident.

Note

Switching off the F-35 28V battery does not provide a hazardous ignition source and is an acceptable procedure during refueling.

11. When hose is fully charged, rotate the nozzle flow control handle to the FULL OPEN position. The handle shall rotate 180 degrees to ensure the poppet valve is fully open and locked. (nozzle operator)

WARNING

The flow control handle of the single point pressure refueling nozzle shall be placed in either of two locked positions — fully open or fully closed. The handle is not to be used as a flag to indicate fuel flow. Excessive wear on the aircraft adapter and the fuel nozzle poppet will result if the handle is allowed to float in the unlocked position.

12. Once fuel flow has been established, exercise the aircraft's precheck system. (qualified personnel)

WARNING

If the aircraft fails pre-check, the hot refueling operation shall be discontinued immediately.



**Note**

- The precheck system simulates the completion of refueling by closing all of the tank shut-off valves within the aircraft. All fuel flow into the aircraft should stop within a few seconds to 1 minute of actuating the precheck system. On aircraft equipped with a fuel indicator, the primary means of detecting successful precheck is by observing the flow indicator on the aircraft to make sure that it stops. If the aircraft is not configured with a flow indicator, or if the aircraft flow indicator is inoperative, the only acceptable means of determining that precheck has been successful is to watch the fuel delivery system's flow counter (flow meter) to ensure it stops. A stiffening (or jerking) of the refueling hose or indication of a fueling pressure spike is not a suitable indication that precheck has successfully occurred (hose stiffening/jerking and pressure spikes can occur whenever one or more aircraft fuel tank refueling valves close).
 - Aircraft may be cold refueled if it fails precheck, but special procedures are required. See appropriate aircraft NATOPS Manual. This should be done only as an operational necessity.
13. Fuel aircraft as directed by the plane captain. The plane captain shall monitor aircraft vents, tank pressure gauge(s), and/or warning lights as necessary.
 14. When directed by the plane captain, release deadman control.
 15. Rotate the nozzle flow control handle into the OFF and fully locked position. (nozzle operator and verified by the station operator)

WARNING

Failure to lock the flow control handle in the OFF position may result in a fuel spray or spill.

16. Disconnect nozzle from the aircraft adapter. (nozzle operator)
17. Stow the pantograph or hose. (nozzle operator and station operator)
18. Complete paperwork. (nozzle and station operators)
19. Ensure area is clear of equipment and personnel.

WARNING

When mobile refueling equipment is used for hot refueling, ensure the aircraft have departed the hot refueling area prior to moving the mobile refueler out of the hot refueling area.

12.6 MULTIPLE SOURCE REFUELING

Normally, only one refueling truck at a time is used to service aircraft; however, there are situations when multi-truck or truck and hydrant servicing is considered desirable, especially when very large aircraft must be refueled. The advantage to multiple source refueling is reduced aircraft turnaround time. The aircraft's NATOPS Manual, USAF Technical Order, or equivalent aircraft servicing manual shall be consulted for specific guidelines and instructions on multiple source refueling before such operations are performed. In addition, the instructions and guidelines on multi-source refueling contained in USAF Technical Order 00-25-172 shall be followed since the vast majority of aircraft involved belong to the USAF. This USAF Technical Order is available from WR-ALC/MMEDT, Robins AFB, Georgia 31098; specific USAF Aircraft Servicing Technical Orders may be obtained from the same source.





12.7 PIGGYBACK REFUELING

Piggyback refueling is a special refueling process sometimes used to refuel very large aircraft such as C-5As or E-6As. Two or more refueling trucks are used. One truck is attached to the aircraft's refueling adapter and other trucks are used to refuel this truck while it continuously refuels the aircraft. This is a potentially dangerous operation and shall be conducted only with properly configured vehicles and under the direct supervision of the FMO. In addition to all of the items required by [paragraph 11.3.2](#) (filter/separator, relaxation chamber) these vehicles shall have both high- and low-level alarms and shutoff systems in place and fully operational.

WARNING

- High-level alarm and shutoff are essential to preventing tank overfill.
- Low-level alarm and shutoff are essential to preventing pump cavitation and/or the pumping of air into the aircraft. These can lead to catastrophic static electric discharges.

Each refueling operation (e.g., the refueling of the aircraft and the refueling of the truck) shall be performed following the procedures for cold refueling with a truck (see [paragraph 12.4.2](#)). A minimum of five people will be needed for these two operations since one person manning a fire extinguisher is sufficient to cover both operations. A detailed local instruction that delineates each individual's responsibilities and duties shall be written to cover this operation.

12.8 TRANSFERRING FUEL FROM ONE AIRCRAFT TO ANOTHER

Some special purpose operations have been developed in which fuel is removed from an aircraft and directly loaded into another aircraft (or ground vehicle). As discussed in [paragraph 12.13](#) of this chapter, aircraft defueling is a very dangerous and demanding operation. In addition, the immediate reuse of fuel removed from an aircraft without proper filtration and handling can adversely affect safety-of-flight. Only NAVAIR approved transfer operations are authorized. Appropriate safety precautions shall be observed at all times during these operations. Specific examples of approved operations listed below:

1. Refueling aircraft, fuel storage bladders, or ground vehicles from KC-130 aircraft.
2. Refueling aircraft, fuel storage bladders, or ground vehicles from CH-53 aircraft.
3. Transfer of fuel between aircraft using Plane-to-Plane Transfer Cart. For a detailed description of this equipment and procedures for its use refer to [Chapter 6, paragraph 6.2.10.2](#) of this NATOPS Manual.

12.9 REFUELING AIRCRAFT WITH AUXILIARY POWER UNIT (APU) RUNNING

The aircraft APU may be used to supply electrical power for pressure refueling on military aircraft so equipped and commercial aircraft (when the procedure is approved by the FAA for the carrier's aircraft in commercial operations). This operation is not considered "hot refueling"; however, the following precautions shall be observed in addition to the normal refueling procedures:

1. One person shall remain outside the aircraft within 10 feet of the APU exhaust with a fire extinguisher of the size specified by the fire chief.
2. The fuels operator will verify the aircraft is grounded.
3. One person shall be located at the GTC controls in the cockpit.
4. Intercom shall be established between cockpit and personnel performing refueling to ensure immediate shutdown in the event of emergency.
5. Personnel in the vicinity of the aircraft shall wear sound-attenuating ear protectors.



**Note**

For P-3 aircraft that have APUs equipped with properly functioning fire sensor/suppressor systems, which are designed to automatically extinguish APU fires, the provisions of [steps 1](#), [3](#), and [4](#) above do not apply.

12.10 CONCURRENT ON-LOADING/OFF-LOADING AND REFUELING OF AIRCRAFT**Note**

Simultaneous fueling of logistical/mobility/commercial aircraft while loading passengers/ cargo, performing minor maintenance, aircrew performing inspections, or operating aircraft systems is considered normal fueling operations, and does not require concurrent refueling procedures. Concurrent refueling procedures are required for refueling with JP-4, or simultaneous refueling while loading/downloading munitions/explosives.

Where concurrent refueling/loading/offloading operations are required, COs shall establish local regulations and procedures to ensure safety. In addition, the CO shall clearly designate one qualified person in charge of each operation. For reference purposes in this chapter, the person in charge will be called the Quick Service Supervisor (QSS), but in actual practice both his/her title and qualifications will be detailed in local regulations.

All tasks concerning the operation will be performed under the observation and control of a QSS. The QSS will be present at the site, be responsible, and have jurisdiction, authority, and coordination over all service operations including refueling trucks/equipment, fueling procedures, power units, loading/unloading equipment, and passenger management and communication systems to ensure safety of all aspects of refueling operations. No concurrent refueling shall commence until the QSS has been identified and established in control. The refueling will commence only upon a signal from the QSS.

The following procedures and precautions shall be included in the local regulations and procedures:

1. All vehicles to be operated within a 50-foot radius of the refueling point shall be equipped with spark arrestors and designated in advance.
2. Appropriate size and type fire extinguishers as recommended by NAVAIR 00-80R-14 shall be located in the immediate vicinity.
3. A stand-by alert crash truck (NAVAIR 00-80R-14 para 5.6.2) shall be required at the aircraft when passengers or patients remain onboard during concurrent refueling operations.
4. When passengers or patients are permitted to remain onboard, necessary ramps (unobstructed) shall be located in the proper position to permit evacuation.
5. Major aircraft maintenance repair work and liquid oxygen servicing shall not be permitted during refueling.
6. A communication system (radio vehicle or other effective means) shall be maintained to permit the CO's designated person-in-charge to contact the stand-by alert crash truck in the event of an emergency.
7. Clear paths shall be maintained around aircraft being serviced at all times.

12.11 DEFUELING AIRCRAFT

Defuelings normally have lower priority than refuelings. A defuel request for an aircraft that is leaking fuel shall be considered an emergency and handled promptly.





- The pump's effluent (discharge) shall be regulated to balance its influent (fuel from aircraft) in order to prevent pump cavitation and/or the loss of suction.
- Damage to aircraft fuel tank can occur if the vacuum pressure exceeds -7 psig.

Note

The desire to satisfy customer requests for the acceleration of the process shall not be granted.

The following rules apply to every defueling operation:

1. Aircraft defueling shall be requested by an authorized representative of the squadron's CO using an Aircraft Defueling Certificate similar to [Figure 12-12](#).
2. During defueling operations, any maintenance not directly required to facilitate the defueling operation is prohibited.
3. Prior to defueling aircraft carrying ordnance, qualified squadron personnel shall verify all ordnance is safed. Safed is defined as the replacement of any mechanical arming level, safety pin, electrical interrupt plug/pin, securing of armament switches, and/or any appropriate action that renders the particular ordnance carried as safe.

WARNING

- Defueling of aircraft with hung ordnance of any type is prohibited.
 - Explosive loaded combat aircraft are not permitted in the fuel pits.
4. Do not start or stop any engine, regardless of its configuration, within 50 feet of a defueling operation. The starting or stopping of an engine within 50 feet of a fueling or defueling operation is sufficient cause for the operator to immediately shut down the fuel pump. Grounding and tiedown pad-eyes shall be available. In addition, at least one fire extinguisher having an ANSI rating of not less than 20-B shall be available in the immediate vicinity of the operation.
 5. Eductor/evacuation systems shall not be used for defueling aircraft.
 6. Suspect aviation turbine fuel shall be removed from the aircraft using a defueler only (not a refueler/defueler) and deposited in a designated holding tank. Ultimate disposition will depend on the results of subsequent laboratory tests. Every effort shall be made to reclaim off-specification fuel as JP-5, F-76, or Fuel Oil Reclaimed (FOR).
 7. All fuel removed from turbine-engined aircraft shall be assumed to be a mixture of lower flash point fuel and JP-5. Defueled turbine fuel shall therefore not be returned to JP-5 storage tanks without first confirming the flash point of the material to be 140 °F or higher.
 8. Fuel containing leak detection dye can be reissued to aircraft of the same squadron as long as the squadron's requesting official signs a statement that the fuel is nonsuspect and is safe for use. Note that although refuelers/defuelers may be used to defuel dyed fuel, this may present logistics problems since it may take several loads of fuel to flush the dye out of the refueler/defueler. The fuel may appear off-color when sampled prior to issue to another squadron's aircraft.
 9. The FMO shall personally decide the disposition of all defueled product. Advice is readily available from the NAVSUP Energy Office.





Figure 12-12. Aircraft Defueling Certificate

AIRCRAFT DEFUELING CERTIFICATE		
PART I [To be completed by person authorizing the defuel operation (person's name shall be on file with the fuel officer).]		
I CERTIFY THAT THE <i>(fill in the specific fuel, if known)</i> AVGAS/TURBINE FUEL <i>(cross out one)</i> TO BE DEFUELED FROM AIRCRAFT NUMBER _____:		
☐	WOULD NOT PREVENT THE RELEASING OF THIS AIRCRAFT FOR FLIGHT.	
☐	IS SUSPECT OF CONTAMINATION WITH _____ _____	
☐	CONTAINS DYE BUT WOULD NOT PREVENT THE RELEASING OF THIS AIRCRAFT FOR FLIGHT. REISSUE DYED FUEL TO AIRCRAFT NUMBERS _____ AND _____.	
THE ESTIMATED GALLONS TO BE DEFUELED ARE: _____		
THE REASON FOR DEFUELING IS: _____ _____		
_____	_____	_____
Signature	Title	Date
PART II [To be completed by operator after completion of defueling operation.]		
METER READING: _____		
VOLUME OF FUEL REMOVED FROM AIRCRAFT: _____		
_____	_____	_____
Signature	Title	Date
Refuel-F029		





10. The defueling unit is required to maintain a flooded suction above the anti-vortex splash plate in its tank in order to minimize turbulence and possible ingestion of air. Historically a minimum of 1,000 gallons has been required in the defueling unit to resolve turbulence and air ingestion problems. Due to the wide variety of configurations of pump piping systems and tank sizes, 1,000 gallons of product may or may not be sufficient. It is up to the local commands to determine the minimum amount by using manufacturers' technical manuals and historical data.
11. Valve(s) that control the flow of fuel from the tank to the upstream side of the pump shall remain closed during defueling operations. This is to prevent the recirculation of product in the tank. Valve(s) may be opened to prime the pump only when the pump is not operating.
12. If during the defuel operation the pump starts to lose prime or cavitates, the operation will be discontinued until the problem is resolved and the fuel supervisor authorizes a restart.

WARNING

At no time will a restart be authorized without waiting a minimum interval of 1 minute to allow dissipation of any static charges.

13. At no time shall defueler tank tops be opened during defueling operations.
14. A special log of each defueling operation shall be maintained. The following minimum information shall be contained in the log:
 - a. Complete list of all squadron personnel authorized to sign defuel request forms. This list will be updated at least quarterly.
 - b. All abnormal happenings.
 - c. Aircraft BuNo.
 - d. Defueler number.
 - e. Grade of product.
 - f. Amount of product actually defueled vice what was scheduled to be removed.
 - g. Scheduled amount to have been defueled.
 - h. Disposition of product.
 - i. Times of the day when the defuel operation was started and completed.
 - j. Names of defueler operator and squadron personnel present during the defuel operation.

12.11.1 Personnel Requirements

Each aircraft defueling operation requires a minimum of three people trained and certified in accordance with [Chapter 8](#); the defuel truck operator, a nozzle operator, and a fire watch.

12.11.2 Defueling Procedures

Aircraft defueling tasks are to be performed in the following sequence:

1. Prior to initiating the defuel operation, take samples of the fuel to be defueled from the aircraft's drains and visually inspect them for contaminants. (Qualified squadron personnel under the observation of the driver operator)
2. Determine the status of the fuel (i.e., suspect or nonsuspect) (defuel truck operator). The person requesting the defueling operation shall confirm that the fuel is or is not suspect. Fuel is considered suspect if the aircraft has malfunctioned and the fuel is believed to have contributed to the problem or the fuel is thought to be of the wrong type (e.g., AVGAS or automotive gasoline instead of aviation turbine fuel).





3. Determine amount of fuel to be removed from the aircraft (defuel truck operator). Again the squadron personnel requesting the defueling operation shall provide this estimate as part of the official request.

Note

If the aircraft is being defueled due to a faulty (or suspect) fuel quantity gaging system, it will be difficult to estimate amount of fuel in the aircraft.

4. Select defueling equipment to be used (i.e., defueler for suspect product or refueler/defueler for nonsuspect fuel) (FMO and station operator). Always check the remaining capacity of the defueler or refueler/defueler to make sure there is adequate room to hold the material being defueled. In addition, remember that sufficient fuel shall be in the defueling tank to maintain a flooded suction above the antivortex splash plate.
5. Position the defueler. (defuel truck operator)
6. Verify aircraft is spotted properly. (all personnel)
7. Check for possible sources of ignition. (all personnel)
8. Verify the defueling request chit corresponds to the instructions from the dispatcher. (defuel truck operator)
9. Connect bonding wire from defueler to aircraft. (defuel truck operator)
10. Unload, position, and connect the defuel hose to the aircraft and the defueling stub on the defueler (plane captain). The defuel hose shall not pass underneath or around the aircraft to reach the refueling receptacle.
11. Commence defueling upon signal from the nozzle operator. (defuel truck operator)
12. Adjust valve downstream of pump to optimize defuel rate.

Note

- Maximum defuel rate is 100 gpm (defuel truck operator). When nearing completion of the defuel process, very close attention shall be paid to the defuel rate in order to prevent pump cavitation and/or loss of prime.
- Discontinue defueling of an aircraft if pump cavitation is a persistent problem.

13. Upon completion of the defuel operation, secure all equipment and check the area for FOD. (all personnel)

12.11.3 Disposition of Nonsuspect Fuel Removed from Aircraft

All USN and USMC aircraft are authorized to use JP-4, JP-8, F-24, commercial JET A and JET A-1, as well as JP-5 fuel. Fuel removed from a USN or USMC aircraft will contain mixtures of these fuels and the specific grade of fuel will be impossible to determine without extensive specification testing. USA and USAF aircraft may also contain such mixtures. Therefore, fuel in any properly operating DOD aircraft with turbine engines, which is not suspect of being contaminated, can be defueled into a designated refueling vehicle and then used to refuel any aircraft with the user's knowledge and permission. First preference shall be given to using the fuel to load an aircraft in the same squadron as that from which the fuel originated. Second choice shall be to issue the fuel to aircraft having engine fuel controls that automatically compensate for fuel density changes. Aircraft with T56 engines, such as the P-3 and E-2, should be preferentially used since these engines are the most tolerant to such fuel changes. In addition the following rules apply to reissuing defueled fuel:

1. Since fuel removed from any aircraft almost definitely has a flash point below 140 °F, it shall not be used to refuel any aircraft scheduled for immediate sea duty.
2. Any designated defuel/refuelers must pass their fuel through filter/separators before reaching the aircraft.
3. The FSII content of defueled turbine fuel must be checked using the FSII refractometer prior to refueling S-3 and SH-60 USN aircraft and all USA and USAF and foreign aircraft.





Nonsuspect fuel that has been dyed for the detection of aircraft fuel system leaks can also be used in aircraft provided the above procedures are followed.

Nonsuspect fuel removed from piston-engined aircraft can also be reissued provided:

1. The fuel is a known grade (80/87 or 100/130).
2. It is properly filtered before reissue.

12.11.4 Disposition of Suspect Fuel Removed from Any Aircraft

Fuel removed from any aircraft that has recently experienced engine or airframe fuel system problems possibly related to fuel quality will be segregated by collecting in a designated defueler, a clean storage tank, or any container as “salvage fuel.” It will then be sampled and tested to determine if it is in conformance with the deterioration use limits outlined in [Appendix B](#). If the fuel tests within the established limits, it shall be returned to station storage and reissued as the grade and type determined providing adequate filtration and water separation can be accomplished prior to dispensing the fuel.

12.11.5 Handling NATO F-37 (JP-8+100)/F-27 (F-24+100) Fuel

NATO F-37 (JP-8+100)/F-27 (F-24+100) is NATO F-34 (JP-8)/F-24 which has been additized with a thermal stability improving additive. The thermal stability additive is a dispersant/detergent that:

1. Disarms filter-coalescer elements.
2. Makes free water readings taken with the digital free water detector unreliable.

It is possible that transient USN/USMC aircraft may receive NATO F-37/F-27 inadvertently when conducting joint operations requiring refueling from air stations operated by the USAF, US Army and NATO member air forces that utilize NATO F-37/F-27.

Note

NATO F-37/F-27 is not authorized for use in USAF or other NATO member nations' aerial refueling aircraft.

If aircraft are suspected of having received NATO F-37/F-27, and need to be defueled, handle defueling as follows:

3. Defuel into refueler/defueler and immediately reissue fuel (as long as no other contamination is suspected). Priority of reissue shall be as follows:
 - a. Directly to same or other aircraft.
 - b. To aviation ground support equipment.
 - c. To aviation test cells.
 - d. Return to bulk storage (RTB), if the dilution ratio is equal to or greater than 1:10 (+100 fuel:bulk storage fuel).

Note

For RTB operations, fuel containing the +100 additive shall not exceed 10 percent of total fuel volume in the tank.

4. If other contamination is suspected, all fuel defueled from the aircraft shall be treated as hazardous waste and handled accordingly.
5. After reissuing NATO F-37/F-27 fuel from refueler/defueler, the following steps shall be taken:
 - a. Refill the refueler/defueler with NATO F-44 (JP-5), NATO F-34 (JP-8) or F-24.
 - b. Note the differential pressure readings for the filter-coalescer elements.
 - c. Issue fuel to aircraft following normal operating procedures.





- d. Change the filter-coalescer when the differential pressure across the filter separator elements reaches 15 psi or the fuel flow degrades significantly.

Notify TYCOMs and AIR-4.4.5 via naval message of any actual/suspected NATO F-37/F-27 defueling.

12.11.6 Disposition of Fuel that Does Not Meet the Allowable Deterioration Limits

Fuels that do not meet the allowable deterioration use limits of [Appendix B](#) will be handled as described below.

12.11.6.1 Disposition of Aviation Turbine Fuels

Aviation turbine fuels that do not meet the requirements specified herein generally cannot be downgraded for any aircraft use. The only significant exception to this rule is JP-5 which has a reduced flashpoint due to mixing with other turbine fuel. As explained above, this fuel is perfectly acceptable for use in USN and USMC aircraft. It shall not be loaded aboard aircraft scheduled for immediate sea duty. Any fuel not meeting the deterioration use limits listed in [Appendix B](#) shall not be issued to aircraft. Questions concerning the use or disposition of fuel not meeting the deterioration use limits should be referred to the NAVSUP Energy Office, Operations Division, DSN 427-7377; commercial 703-767-7377.

12.11.6.2 Disposition of Aviation Gasoline

Any questions concerning the use or disposition of fuel not meeting the use limits should be referred to the NAVSUP Energy Office (Code 70), DSN 427-7377; commercial 703-767-7377.

12.12 SHORE STATION REFUELING PROCEDURES FOR COMMERCIAL CONTRACT HELICOPTERS

Commercial contract helicopters are being used more frequently to provide logistical support to fleet units. Commercial helicopters used for these purposes may operate out of Navy/Marine Corps air stations. All refueling procedures contained in this chapter apply to the refueling of commercial helicopters on Navy/Marine Corps air stations with the following modifications:

1. Cold refueling of commercial helicopters. Cold refueling shall be performed by the use of a gravity nozzle or, if the helicopter is equipped with either a SPR or CCR fueling adapter, by a D-1 or 15-psi regulated CCR nozzle. All commercial helicopters equipped with SPR or CCR fueling adapters are also capable of being gravity refueled.
2. Hot refueling of commercial helicopters. Hot refueling of commercial helicopters is only authorized if such helicopters are equipped with either SPR or CCR fueling adapters. If a commercial helicopter is equipped with a CCR fueling adapter it shall only be hot refueled using a 15-psi regulated CCR nozzle.
3. Since 15-psi regulated CCR nozzles are not standard air station fuel department equipment, any commercial helicopter operator desiring to refuel onboard a Navy/Marine Corps air station by means of the CCR fueling adapter will need to provide the necessary 15-psi regulated CCR nozzles and the adapters necessary to mate with the air station's refueling equipment hoses.

12.13 PRODUCT RECEIPT

12.13.1 Barge or Tanker Receipt of Product

Barge or tanker receipt of product requires advance planning. The FMO will post written orders designating the following:

1. Pier preparation and inspection.
2. Pipelines to be used.
3. Number and sizes of hoses to be connected.
4. Tanks into which cargo is to be received.





5. Pumphouses and pumps to be operated.
6. Number of samples and location where samples are to be taken.
7. Tests required.
8. Communications to be used.
9. Personnel assignments.
10. Preparation of the "Declaration of Inspection" (an Environmental Protection Agency requirement in the 33 Code of Federal Regulations [CFR] administered by the Coast Guard).

The activity instruction shall cover standard operating procedures for:

1. Filling of lines before the barge is docked.
2. Notification to start unloading.
3. Unloading speed.
4. Line patrol and gauge check.
5. Changing tanks.
6. Change in pump operation.
7. Barge stripping procedure and stripping speed.
8. Final inspection of barge tanks.
9. Draining pier lines.
10. Personnel manning level.
11. Personnel training requirements.
12. Special clothing requirements.
13. Fuel sampling and testing requirements.

12.13.2 Pipeline Receipt of Product

Pipeline receipt of product requires essentially the same advance planning as barge receipt and a written order is required. Some pipeline operations, however, are relatively simple and therefore require minimum personnel.

12.13.3 Tank Truck/Tank Car Receipt of Product

Incoming tank trucks and tank cars of aircraft fuel can arrive separately or in groups. All shall be sealed at the source of supply. Unloading of tank trucks requires approximately 1/2 hour and is a 2-man operation. Tank cars are usually left on a siding or in place for the offloading operation. The following procedures apply to both tank truck and tank car receipt:

1. Ensure seals are intact.
2. Verify seal number is identical to that on the shipping document.
3. Verify the specification and grade number of the product on the shipping document.
4. Ensure the fuel level coincides with the marking on the tank and the quantity on the shipping document.
5. Take bottom sample from each compartment, first drawing off water if present.
6. Make visual test of samples.
7. Unload product into a segregated storage tank.





8. Check vehicle's tank interior after delivery.
9. Upon completion of fuel receipt (multiple tank car or truck loads), sample storage tank and perform quality control tests.

12.13.4 Aviation Fuel Settling

After fuel has been received into bulk storage tanks, allow the maximum possible settling time in order to permit reasonable settlement of water and sediment/particulate matter. At a minimum, allow a settling time of 8 hours prior to issue or transfer. In case of emergency, fuel may be transferred in less than 8 hours with TYCOM approval.

WARNING

When aviation fuel is received directly from suppliers, simultaneous receipt and issue from the same tank, other than tanks supplying direct fueling stations or Type III hydrant systems, is prohibited.

Note

When operational commitments repeatedly limit settling time to less than 8 hours, corrective action (i.e., programming new or additional tankage) should be taken.

Exceptions to the settling time requirement:

1. Interior epoxy-coated tanks with receipt filter-separators, and tanks of non-ferrous material with receipt filter-separators, do not need to meet the minimum settling time requirement.
2. Tanks of 50,000 gallons or less that do not receive fuel directly from suppliers do not need to meet the settling time requirement.

12.14 CHANGE OF PRODUCT IN AIRCRAFT REFUELERS

Change of product in mobile refuelers shall be performed in accordance with [Figure 12-13](#). Product that is used to flush tanks and piping shall be treated as contaminated fuel. Samples shall be visually inspected for sediment/particulates and water and its specific gravity shall check within 0.5 degrees of the corrected API of the appropriate product in storage.

12.15 CHANGE OF PRODUCT IN STORAGE TANKS

The NAVSUP Energy Office, Ft. Belvoir, VA shall be contacted concerning instructions for the change of product grade in storage tanks.





Figure 12-13. Change of Grade Procedures for Aircraft Refuelers

LAST PRODUCT CARRIED	PRODUCT TO BE LOADED			
	NONLEADED GASOLINE/AVGAS	TURBINE FUEL AVIATION (KEROSENE TYPE) JP-8 (F-24)	TURBINE FUEL AVIATION (HIGH FLASH POINT KEROSENE TYPE) JP-5	DIESEL
Nonleaded Gasoline/AVGAS	A	B	B, D	B
Turbine Fuel Aviation (Kerosene Type) JP-8 (F-24)	B	A	B, D	B
Turbine Fuel Aviation (High Flash Point Kerosene Type) JP-5	B	A	A, D	A
DIESEL	B	B	B, C	A
NOTE 1: When draining railcar and tank vehicle particular attention should be given to sumps, pumps, filters, hoses, and other components likely to trap quantities of liquid. NOTE 2: In all cases, lines, etc., are to be drained to fullest extent practicable and the following action taken: A. None, fill with desired product. B. Flush with desired product, drain, fill with desired product. (See NOTE 1) C. Inspect for and remove all sludge, in particular traces of lead and gum. Flush with desired product, drain, fill with desired product. D. Test for flash point. NOTE 3: This modified table complies with NATO STANAG 3149.				





CHAPTER 13

Maintenance of Refueling Facilities at Shore Activities

13.1 GENERAL REQUIREMENTS

This chapter highlights maintenance actions that are critical to the delivery of clean, dry, uncontaminated fuel to aircraft using safe fuel handling equipment and procedures.

In addition to the guidance provided herein, activities shall follow the detailed maintenance programs defined in UFC 3-460-03 Operation and Maintenance: Maintenance of Petroleum Fuel Systems. This UFC shall be the primary guide used when maintaining aviation fuel facilities.

Each activity shall establish a Preventive Maintenance (PM) program based on COMNAVAIRFORINST 4790, UFC 3-460-03, and this NATOPS Manual. An automated PMS program is available from the TYCOMs, the NAVSUP Energy Office, and NAVFACENGCOM.

WARNING

Failure to follow the requirements and procedures contained in this chapter can adversely affect safety of flight for the aircraft being refueled as well as the general safety of fuel handling operations.

13.2 RESPONSIBILITIES

The CO of each Navy and Marine Corps activity is responsible for the fuel aboard his station and auxiliary activities under his command. The entire responsibility, including the maintenance and safe operation of the fuel storage and handling facilities, is delegated to the Supply Officer who, in turn, delegates these fuel duties to the FMO. Maintenance of the aviation fuel facilities and equipment is one of the primary responsibilities of the FMO and his Fuel Division.

The FMO is responsible for many maintenance actions since they fall within the capabilities of his assigned personnel. Even when outside resources and manpower are needed for maintenance actions, it is the FMO's responsibility to initiate such actions. The Public Works Officer (PWO) must provide most of this assistance.

One of the most important duties of the FMO at shore stations is to initiate facility improvements and upgrades. NAVAIR, NAVFAC, the NAVSUP Energy Office, and the TYCOMs are available to provide assistance to any station with upgrade and modernization programs. Long term, programmed maintenance shall be coordinated with the public works forces and other activities, particularly NAVFAC Field Division personnel, the Coast Guard, OSHA and EPA. It should be noted that even under ideal conditions, MILCON projects take approximately four years from day of submission to the day ground-breaking takes place. The FMO is responsible for keeping all maintenance, repair, and inspection reports on file for fuel servicing equipment and facilities under his/her jurisdiction. Whenever equipment facilities are reassigned, the records shall be forwarded to the new owner.

13.3 PREVENTIVE MAINTENANCE PROGRAM (INSPECTIONS)

Although a well-executed and documented PM program will substitute for many of the routine inspections, a formal inspection program is necessary. The implementation of an inspection program is the responsibility of the FMO and shall include:

1. Inspections of equipment and facilities prior to use.





2. Inspections prior to major operations.
3. Seasonal or special inspections.
4. Routine inspections and checklists.

13.3.1 Inspections Prior to Use

New construction, out-of-service facilities, broken down equipment, and facilities and equipment that have been provided with corrective or programmed maintenance, shall be inspected prior to acceptance or reactivation. Special attention should be given to rated capacities of hardware, pipeline sizing, drainage, accessibility, emergency controls, safety, and fire prevention features.

Inspections shall be conducted prior to starting major operations (e.g., receipt of product to or from ships or between large storage tanks, or high-tempo training exercises). Inspections should cover equipment performance, pipeline integrity, valve positioning, tank arrangement, and personnel manning.

13.3.2 Seasonal or Special Inspections

In climates where freezing weather is encountered, winterization inspections should be made in the early autumn. Extensive inspections for damage or malfunctioning should be conducted following any storm, flood, fire, earthquake, lightning strike, suspected act of sabotage, or vandalism. Special inspections are called for when abnormal variations of performance, flow rates, pressures, or capacities are experienced or noted by operators. Special inspections, performed by personnel from other departments, may be conducted upon request, or as required, on electrical equipment, communications equipment, buildings, security fences, roadways, and fire prevention equipment.

13.3.3 Aircraft Refueling Equipment Checklists

Each activity shall use daily, weekly, monthly, and periodic checklists similar to those contained in [Figures 13-1, 13-2, 13-3, and 13-4](#). Locally developed checklists that are specific to individual installations or systems may be substituted.

13.3.3.1 Daily Checklist

The daily checklist shall be completed on all aircraft fuel delivery equipment that is in continuous use, once in every 24-hour period on a not-to-interfere-with-aircraft-servicing basis.

WARNING

Equipment that fails to meet established requirements shall be removed from service until corrective action has been completed.





Figure 13-1. Daily Aircraft Refueling Equipment Checklist

Vehicle or Hydrant #		Meter Reading		Product	Date _____ Time _____
#	Item (See paragraph 13.3.3.1)	OK	Adjust	Repair	REMARKS
1	Fire extinguishers (in place, filed, operable, current inspection tag)				
2	Nozzle stowage dust cover and bonding cable on gravity nozzle				
3	Hook up nozzle to bottom loading adapter or recirculation fitting, and check entire nozzle assembly				
4	Hose: Check entire length for cuts, cracks abrasions, and fuel saturation				
5	Static bonding cable, plug/clip				
6	Leaks (tank, piping, valves, pumps, etc.)				
7	Emergency valves (operation of controls)				
8	Cleanliness				
9	No FOD in tires				
10	Battery, radiator, gas, and oil levels				
11	Lights, reflectors, rearview mirrors				
12	Drain all low point drains (tank, filter/separator, relaxation chamber)				
13	Exhaust pipe and spark arresting muffler (leaks, cracks, or noise)				
14	Emergency brakes				
15	Drain water from air tanks				
16	Fill hose with full pump pressure and check entire system for leaks				
17	Open nozzle valve, check nose seal for leaks, circulate fuel, and check flow rate				
18	Pump (noise, overheating, vibration)				
19	Draw nozzle sample, visually inspect for water, solids and color and record results	Water _____ Sediment/Particulates _____ Color _____			
20	Record pressure differential reading from filter/separator	Pump Pressure _____ Filter Pressure Diff. _____ Pump RPM _____ Flow Rate _____			
21	Take samples during recirculation and test using CCFD and DFWD	Sediment/Particulates by CCFD _____ Water by DFWD _____			
COMMENTS:					
INSPECTOR'S SIGNATURE			SUPERVISOR'S SIGNATURE		





Figure 13-2. Weekly Aircraft Refueling Equipment Checklist

Vehicle or Hydrant #		Meter Reading		Product	Date _____ Time _____
#	Item (See paragraph 13.3.3.2)	OK	Adjust	Repair	REMARKS
1	Complete Items 1-21 on the Daily Checklist				
2	Take samples during recirculation and test using CCFD and DFWD.				
3	Inspect and clean refueling nozzles (SPR and gravity)	Description of Screen Contents: SPR _____ Gravity _____			
4	Inspect tires, brakes, horn, windshield wipers, steering, trailer coupling and electrical wiring				
COMMENTS:					
INSPECTOR'S SIGNATURE			SUPERVISOR'S SIGNATURE		





Figure 13-3. Monthly Aircraft Refueling Equipment Checklist

Vehicle or Hydrant #		Meter Reading		Product	Date_____Time_____
#	Item (See paragraph 13.3.3.3)	OK	Adjust	Repair	REMARKS
1	Complete daily and weekly checklists				
2	Check electrical resistance of all bonding and ground cables and reels				
3	Inspect and clean all line strainers				
4	Test anti-drive away device				
5	Perform engine spark test				
6	Test maximum flow rate				
7	Test primary pressure control				
8	Check refueling adapters				
9	Check equipment markings				
COMMENTS:					
INSPECTOR'S SIGNATURE			SUPERVISOR'S SIGNATURE		





Figure 13-4. Periodic and Annual Report

PERIODIC AND ANNUAL RECORD FOR _____													
Equip. type & #	Spring			Summer			Autumn			Winter			Remarks
	OK	Adj	NR	OK	Adj	NR	OK	Adj	NR	OK	Adj	NR	
Brake linings/pads													
Headlight beams													
Wheel inspection													
Suspension inspection													
Calibrate pumps & meters													
Calibrate pressure gauges													
Body Inspection													
Paint and decals													
Record Dates Performed													
	Spring			Summer			Autumn			Winter			
Oil change/lubricate													
Tank interior and manhole covers													
Winterize													
Filter element change													
Product change & flush													
Brake linings replaced													
Cabin carbon monoxide check													
Test hose end pressure regulator													
Hydrostatic test of refueling hose													
Others (list)													
Inspector's Signature													
Supervisor's Signature													





The following detailed discussions pertain to the serially numbered items in [Figure 13-1](#), Daily Checklist:

1. Fire extinguishers. Report discrepancies immediately and do not use the equipment until certified.
2. Inspect nozzle for damage; check nose seal for cracks or nicks, outer shell for tightness to top connection, safety wire on lock bolt, handles for tightness, and flow control handle for excessive wear, cracks or breaks.
3. Hook up nozzle to bottom-loading adapter or recirculation fitting and inspect the entire nozzle assembly for broken, cracked parts, or evidence of leaks.
 - a. Aircraft refueling nozzles shall be stored with their dust covers in place.
 - b. On mobile refuelers, nozzles shall be stowed in a manner that will prevent them from falling or dragging from the vehicle in motion. At no time will nozzles be allowed to extend beyond the extremities of the unit while in transit. Nozzle storage shall provide protection from the environment and in particular, the nozzle face seal and poppet areas to prevent their damage and contamination. Special attention shall be placed on the positioning of nozzles in storage to ensure accumulation of dirt and water is minimized.

Note

When nozzles are allowed to hang inverted, exposed to the environment, water and dirt may build up in bearing collar and nose seal areas.

4. Inspect the entire length of the hose thoroughly. Special emphasis should be placed on the area close to the nozzle and near the connection at the opposite end where hose should be pressed and tested for soft spots around its entire circumference. Be alert for blisters and wet spots. Any exposed hose reinforcement material is cause for hose replacement because exposed fabric provides a source for water to enter, migrate, and ultimately rot the fabric. Inspect the area around hose end couplings for slippage (evidenced by misalignment of hose and couplings and/or scored or exposed areas). Painting a strip across the coupling and hose will aid in this inspection since the unpainted part of the hose that was underneath the coupling will become visible if the coupling slips any significant amount. A hose assembly that has been subjected to abuse, such as severe end pull, flattening or crusting by vehicle, sharp bending or kinking, shall be removed from service. All hoses, whether in service or in reserve, shall be stored as follows:
 - a. Store all hoses in a manner that prevents twists, sharp bends, or kinks.
 - b. Protect hoses, not used daily, from the sun in order to reduce ultraviolet deterioration.
 - c. Cover both ends to prevent damage to threads and the introduction of contaminants.
 - d. Store hoses off the ground to prevent the collection of water and dirt. Hoses being removed from service for an extended period of time shall be drained of all fuel and the ends capped prior to being placed in storage. When returning a stored hose to aircraft fuel service, it shall be flushed thoroughly. Fuel samples taken at the nozzle shall meet the quality standards of [Chapter 9](#) or the hose will not be used for aircraft refueling.
5. Bonding cables shall be in place and in good condition, clean and with serviceable plugs and clips securely attached. If grounding cables are used a similar check should be made.
6. Carefully inspect tanks, piping, valves, pumps, meters, and couplings for leaks. If any leaks are found, record the location and immediately “down” the equipment. It shall not be used until repaired.
7. Check emergency valve controls for condition and ease of operation. If air-operated, build up system pressure and check operation of the controls. Keep emergency valve closed at all times except when delivering fuel or circulating product.
8. Exterior surfaces should be wiped clean of oil, grease, and fuel. Ensure cabinets, troughs, cab, and any enclosure is free of an accumulation of fuel, dirt, cleaning material, and unnecessary items. Check fenders and mudguards to ensure adequate protection against throwing of mud and dirt on fueling equipment and rear of unit.
9. Ensure that there is no FOD in the tires.





10. Check the fluid levels of the battery, radiator, gas, and engine oil.
11. Ensure lights are operable, all electrical wiring outside of cab is enclosed in tubing, and rear view mirrors are serviceable.
12. With equipment in level position, drain product from the manual low point drain of the tank into a clean container. If water is found, empty sample into salvage container and repeat the process until a clean, water-free sample is obtained.
 - a. Open the filter/separator manual drain valve and drain off all water. After all water has been drained, draw approximately one pint of fuel into a clean container and visually inspect for water. Repeat as necessary until only clean, bright fuel is obtained.
13. Carefully inspect the exhaust pipe and muffler(s) system(s), including any auxiliary engine system, for leaks, cracks, noise and proper placement. Ensure clean-out port in spark arrestor is covered. Flex piping is not authorized.
14. Check the emergency brakes to ensure there is plenty of throw on the emergency brake handle and that brakes hold.
15. Drain air tanks of moisture and check for fuel contamination. Malfunctioning air-operated valves that control fuel flow and check valves have been cited as causes for fuel entering brake air systems. The smell of fuel or fuel droplets in the air being bled off is cause for immediately “downing” the equipment until the problem is resolved. The most common source of fuel or fuel vapors in the air system is the rupture or cracking of a diaphragm in the fuel flow control valve. In addition, corrosion resulting from moisture in the air system can cause one-way check valves to remain open thus allowing fuel into the system.
16. Engage the pump and pressurize the system. Check entire system for leaks. The maximum allowable circulation time for refuelers, less than one half full, is three minutes. Hose inspections in item number 4 above should be conducted during circulation. Check to see if fuel is leaking from the vent port on the hose end pressure regulator. If fuel is leaking from this port, remove the hose end pressure regulator from service and repair it.

WARNING

- Equipment that fails to meet the established requirements shall be removed from service until corrective action has been completed.
 - The vent port on the hose end regulator shall never be plugged since it is critical to proper operation.
17. Place the nozzle's flow control handle to the fully opened and locked position and circulate fuel. Circulation is to be performed through either the bottom loader or recirculation receptacle on the same or another unit. (An adapter is necessary for overwing nozzles.) On refueling trucks, circulation is to be performed at standard rpm settings where flow rates can be measured and differential pressure readings are meaningful. Circulation of trucks must be limited to a period of 10 minutes, each followed by a 1-minute rest period to allow electrostatic charges to dissipate. All equipment must be circulated for a time period that is sufficient to flush out all piping downstream of the filter separator elements.
 18. Check operation of the pump. Listen for unusual sounds and feel for overheating and/or abnormal vibrations.
 19. Remove a fuel sample from the quick disconnect sampling port on the nozzle and check its cleanliness, brightness, and color. The sample should be drawn as rapidly as possible without spilling fuel. Swirl the fuel to form a vortex and check for sediment/particulates on the bottom. Check brightness or clarity under good light conditions. The sample should be free of any emulsion, cloud, or haze. Record the actual physical condition of the fuel on the checklist.
 20. With system recirculating, observe the pressure drop across the filter/separator. The daily pressure drops across each filter/separator shall be recorded in a special log similar to the one shown in [Figure 13-5](#). The





system shall be operating at standard flow conditions (e.g., during recirculation or flushing). Enter the differential pressure calculation on the checksheet and the pressure differential log for the equipment.

WARNING

Differential pressure readings shall only be made when the system is operating at standard conditions since the accuracy of the differential readings is directly dependent on the system's overall flow and pressure conditions. Use of nonstandard, variable operating conditions makes the results meaningless and will prevent the identification of filter element failures.

Note

If standard conditions do not reflect the rated capacity of the filter/separator, the pressure differentials will have to be calculated as follows:

- True differential pressure =
(Rated flow/Standard flow) measured differential pressure.
- Example:
A 5 psi differential pressure is obtained when operating a 600 gpm system at 300 gpm.
- True differential pressure = $(600/300) 5 \text{ psi} = 10 \text{ psi}$.

21. Take samples during recirculation and test using CCFD and DFWD.

13.3.3.2 The Weekly Checklist

In order to provide continuity to the checks of the various items, the Weekly Checklist (Figure 13-2) shall be performed by a senior operator or fuel shop personnel. The weekly inspection shall be performed on all equipment being returned to service, following any down time that exceeds 72 hours.

The following discussion pertains to items shown in Figure 13-2. Weekly requirements are:

1. Complete the daily checklist.
2. Take samples during recirculation and test, using CCFD and DFWD. This sampling effort may be conducted a few days prior to the time the remainder of checklist inspections are performed; however, the results from the CCFD and DFWD shall be entered in the appropriate laboratory log.
3. All underwing and overwing nozzle screens shall be cleaned and inspected. This may require removal and replacement of the complete nozzle assembly. If screens are removed and replaced, a method of identifying the refueling unit from which each screen was taken is important.
 - a. Screens should be cleaned with compressed air to extend their life. Analyze the contents of nozzle strainers over a collection pad. Rubber particles in screens are often the earliest evidence of hose deterioration.
 - b. When reinstalling nozzle screens, it is necessary to ensure there is no movement of the nozzle strainer that may allow fuel to bypass around the outside of the strainer, allowing possible contamination to enter aircraft fuel tanks.
 - c. Detailed instructions, expanded illustrations, and troubleshooting tables of the nozzles and couplings in use shall be available and posted in the workshop.



[illegible]



4. Inspect tires, brakes, steering, lights, and fifth wheel (use of a transportation inspector may be beneficial for this).
 - a. Brake linings and/or pads shall be checked by normal application of the brake while observing the pedal travel. (The measurement of actual stopping distances, following a maximum application of brakes, is considered too severe and hazardous a test for refuelers.)
 - b. Test the emergency brake under drive conditions. It is important to ensure against “creep” during a fueling operation.
 - c. Ensure all electrical wiring outside of the cab is encased in tubing that terminates in securely mounted vapor-tight fixtures or junction boxes with compression fittings.

13.3.3.3 Monthly Checklist

The Monthly Checklist, [Figure 13-3](#), requires special equipment and moving of mobile equipment to a location other than the operating area. The following discussion pertains to items in [Figure 13-3](#). Monthly requirements are:

1. Complete Daily and Weekly Checklists.
2. Check continuity of grounding cables, bonding cables, and reels if they are stowed in that manner. Continuity shall be measured with cable in the stowed, fully extended, and intermediate condition. Check the continuity of the grounding cable on each overwing refueling nozzle.
3. Inspect and clean all line strainers, including meter strainers, when installed. These screens protect expensive downstream components of a fueling system. The inspection and cleaning interval for line strainers may be lengthened to quarterly, if access is difficult; however, under no circumstances shall the time interval exceed three months since the existence of foreign matter in line strainers could forewarn of problems before complete breakdown.
4. Test the anti-driveaway device installed on all refuelers.
5. Perform engine spark check at night. Its purpose is to locate any electrical traffic over the outside surfaces of wiring, spark plugs, etc. Any auxiliary engines should be included in the test. Any observed arcing, however slight, is sufficient cause to remove the equipment from service.
6. Test maximum flow rate. The maximum flow rate for fueling aircraft is 600 gpm and the maximum allowable pressure at the skin of the aircraft is 55 psi. Flow rates may vary depending on the design and installation of the equipment. Historical records of the pressures and flow rates shall be maintained to aid in identifying long-term mechanical wear (i.e., pump wear rings, diaphragm ruptures).



If pressure tests indicate nozzle pressure test exceeds 55 psi or the flow rate exceeds 600 gpm, the equipment shall be removed from service.

7. Test of the primary pressure control system shall be performed with the hose end regulator blocked out or removed from the system. The following general procedure describes how to test the performance of the basic or primary pressure control system on all refueling equipment:
 - a. Install a pressure gauge (0 to 100 psi single line increments) into the nozzle sampling connection.
 - b. Either remove the hose end regulator from the system by exchanging the nozzle assembly for one without a pressure regulator or attach a “block-out” device to the hose end pressure regulator to prevent it from operating (i.e., controlling nozzle pressure). The block-out device equalizes pressure on both the inside and outside of the hose end pressure regulator which prevents it from operating. Block-out devices for hose end pressure regulators, along with instructions for their use, are available from the regulator manufacturers.





At no time shall a block-out device remain installed during aircraft refueling operations.

- c. Set up system for circulation of fuel.
- d. With system operating at normal flow rate, slowly close the nozzle's flow control handle until the flow of fuel is completely stopped while watching the pressure gauge in the nozzle. Keep truck or fixed equipment (pump) operating. This action simulates the aircraft shutting down the fuel flow. If pressure climbs above 50 psi, the primary pressure control system is either incorrectly set and must be adjusted, or the system is malfunctioning and must be repaired.

Note

- In addition to primary pressure control, the refueling control valve also provides a surge-pressure quick shutdown feature. In the event of a quick downstream flow shut off, either from an aircraft high-level shutoff or from the quick closure of the HEPR, the surge shutoff pilot valve will quickly close the fueling control valve (whether the deadman is released or not). This feature protects the fuel hardware between the fueling control valve and the nozzle from high pressure spikes. In order to prevent fighting between the valves, pilots must be adjusted in sequence in descending order of pressure: 1) HEPR — 55 psi (fixed-spring); 2) Surge shutdown — 50 psi; 3) Primary pressure control — 45 psi.
 - When adjusting the surge and primary pressure controls, block out the HEPR. For HEPRs with lower pressure settings, the surge and primary pressure control shall be adjusted downward accordingly, with approximately 5-psi spacing.
- e. After verifying the integrity of the primary pressure control system, remove the block-out device and open and close the nozzle a minimum of three times under flow conditions. Fuel that has been trapped in the cavity during the test will be pumped out through the vent port. Replace hose end pressure regulator vent screen in appropriate port if it was necessary to remove it.



If the pressure exceeds 55 psi, remove the equipment from service until both the primary pressure control system and hose end pressure regulator are adjusted and/or repaired.

8. Check refueling adapters (receptacles) using the go/no-go gauge (NSN 5220-01-301-9247) or alternate go/no-go gauges (NSN 5220-01-343-1688, 5220-01-554-2538).

WARNING

A worn or broken adapter can defeat the safety interlocks of the refueling nozzle, permitting the poppet valve to open and fuel to spray or spill.

9. Ensure fuel handling equipment is marked in accordance with NAVFAC P-300 or MIL-STD-161.





13.3.3.4 The Periodic Inspection and Annual Record

The Periodic Inspection and Annual Record, [Figure 13-4](#), provides an important historical record for each piece of refueling equipment. The frequencies are absolute minimums. Local conditions may require more frequent inspections. The N.R. in seasonal columns translates to needs repair and does not mean not required. The inspection items contained in this checklist are self-explanatory.

WARNING

Tank interior and manhole cover inspection in [Figure 13-4](#) is the only time, other than the performance of tank maintenance and cleaning, when manhole covers are to be opened. Manhole covers should be semi-permanently secured with padlocks or by other means. Opening the manhole cover presents several dangers including the possible introduction of ignition sources into the flammable vapor space of the tank as well as contaminants into the fuel.

13.3.3.4.1 Hose End Pressure Regulators

Hose end pressure regulators shall be tested for performance and integrity annually. Since this test requires readjustment of the primary pressure control of a refueling system to a much higher than normal setting, it is recommended that each activity:

1. Select one refueling system for conducting this test on all its hose end regulators.
2. Shall not refuel any aircraft with the selected system until the primary pressure regulating system has been reset to normal conditions.

Test hose end pressure regulators as follows:

- a. Adjust the primary pressure control of the selected refueling system to a value of 73 to 76 psi.

WARNING

The primary pressure control shall be reset to 50 psi at the refueling nozzle before the system is used to refuel aircraft. Overpressurization of an aircraft's fuel system could result in the rupture of a tank, fuel spill, and fire.

- b. The HEPR regulates outlet pressure to a nominal 55 ± 5 psig. Since it does so by restricting flow, it may regulate closer to 60 psig at low flow rates while allowing 50 to 55 psi at typical fueling rates. Insert a pressure gauge (0 to 100 psi) into the nozzle gauge port. The outlet pressure shall not exceed 60 psi at flowrates between 0.50 and 2 gpm.

CAUTION

If the nozzle pressure exceeds 60 psi at flow rates above 0.50 gpm, remove regulator from service.

- c. Under flow conditions, slowly close the downstream valve in approximately 3 seconds. Upon closure, observe gauge for approximately 10 seconds. If pressure increases, remove unit and replace seal. It is not unusual for the gauge to read between 55 and 80 psi. This is because the gauge has trapped some of surge generated by closing the valve.





The primary pressure control system shall be readjusted to 50 psi before refueling any aircraft.

13.3.3.4.2 Hydrostatic Testing of Refueling Hose

Hydrostatic testing of refueling hose shall be conducted prior to installation and annually or whenever the integrity of the hose is suspect. Hydrostatic testing shall be in accordance with ASTM D380 (paragraphs 14, 15, 17, 17.1, 17.1.1, 17.1.5) at a pressure of 120 psi.

Note

Stencil hose with date test was performed.

13.3.4 Filter/Separator — Pressure Log and Graph

Filter/separators are critical components in aviation fuel handling systems and their performance shall be carefully monitored. They provide the primary means of assuring that only clean, dry fuel is loaded into aircraft. In addition to the daily, weekly and monthly inspections and tests for sediment/particulates and water performed on fuel samples taken downstream of the equipment (such as at the refueling nozzle), it is essential that the pressure drop across each housing be accurately determined so that the integrity of the elements can be verified. Ruptures or breaks are identified by a significant drop in the differential pressure. Over time the differential pressure across the filter elements will increase as more and more dirt and/or water is trapped. All activities shall maintain a log similar to [Figure 13-5](#) for each filter vessel. In addition, it is mandatory that activities plot the monthly readings on a graph such as shown in [Figure 13-6](#). This will provide an instant picture of what is happening and has been shown to be helpful in determining a rupture or indicating that the elements are no longer useful.

13.3.5 Filter/Separator Element Change

Coalescer elements in refueling equipment or at truck fill stands shall be changed every three years unless an earlier change is forced by one of the below criteria.

1. Pressure differential has reached the lower of manufacturer's recommendation or 20 psi.

Note

Differential pressure measurement must be made at rated capacity or calculated as discussed in [paragraph 13.3.3.1, step 20](#).

2. The graph of differential pressures turns downward, indicating a rupture.
3. The graph fails to increase after an extended period indicating either ruptured elements or improper installation.

During filter changes, the permanent second stage water separator elements should be tested for their ability to repel water. If the separator element does not repel or cause the water to bead, it should be washed with warm water, thoroughly rinsed, and tested again.

Whenever coalescer elements are changed, use stencils or embossing tape (0.75 to 1-inch (19 to 25 mm) letters) to permanently mark filter separators with date changed, due date for next change, and maximum differential pressure.

All discarded filter elements shall be disposed of in accordance with local hazardous material instructions.

13.3.6 Storage and Distribution Facilities Checklist

The [Figure 13-7](#) checklist is presented as a guide to illustrate a method for recording operator and preventative maintenance for the storage, distribution systems, and fuel facilities. This checklist does not provide full coverage and shall be expanded locally to include all fuel related equipment. The [Figure 13-7](#) checklist, when tailored to the activity fuel facilities, will serve as a basis for ordering corrective maintenance.





13.3.7 Calibration

Calibration is required for deadweight testers, master meters, and meters/gauges used at the point-of-sale. Personnel who have been certified by an official Navy calibration laboratory (or other certifying agency) shall perform these calibrations. Non-certified personnel may calibrate meters/gauges that are not used at the point-of-sale by means of a master meter or deadweight tester. Non-certified personnel performing calibrations on non-point-of-sale meters/gauges should be familiar with proper calibration procedures.

13.4 RECORDS AND REPORTS

Observation of abnormal operating conditions is vital to a good preventative maintenance program. The detection of small operating faults and their subsequent minor correction or repair can often avert the development of major problems requiring extensive repairs. Such conditions must be promptly reported to the proper authorities in order to achieve the necessary repairs or corrections. These deficiency reports must be in written form.

Maintenance records. A facility shall maintain records in sufficient detail to provide the following:

1. Identify each major structure, equipment item, group of items, or system.
2. Current maintenance status, including unfunded deficiencies and uncompleted job orders.
3. Past maintenance history, including description and cost of major repairs or replacements.
4. Recommendations for future programmed repairs or replacements, including estimates of funds or manpower requirements.

Whenever major problems are noted with refueling facilities or equipment that could possibly be a result of a design or manufacturing flaw, forward details to the appropriate cognizant Systems Command Headquarters for investigation and resolution.

Report problems with installed facilities to:

Naval Facilities Engineering Service Center
Office of the Chief Engineer, Code 00CE3
901 M Street, SE Bldg. 218
Washington, DC 20374-5018

Telephone: 202-433-8764 or DSN 288-8764
Telefax: 202-433-8777

Report problems with refueling vehicles, nozzles, filter/separator elements, and fuel quality monitoring equipment to:

Naval Air Systems Command
AIR-4.4.5 (Fuels), Bldg. 2360
22229 Elmer Road, Unit 4
NAS Patuxent River
Patuxent River, MD 20670

Telephone: 301-757-3406 or DSN 757-3406
Telefax: 301-757-3614

13.4.1 Record Retention

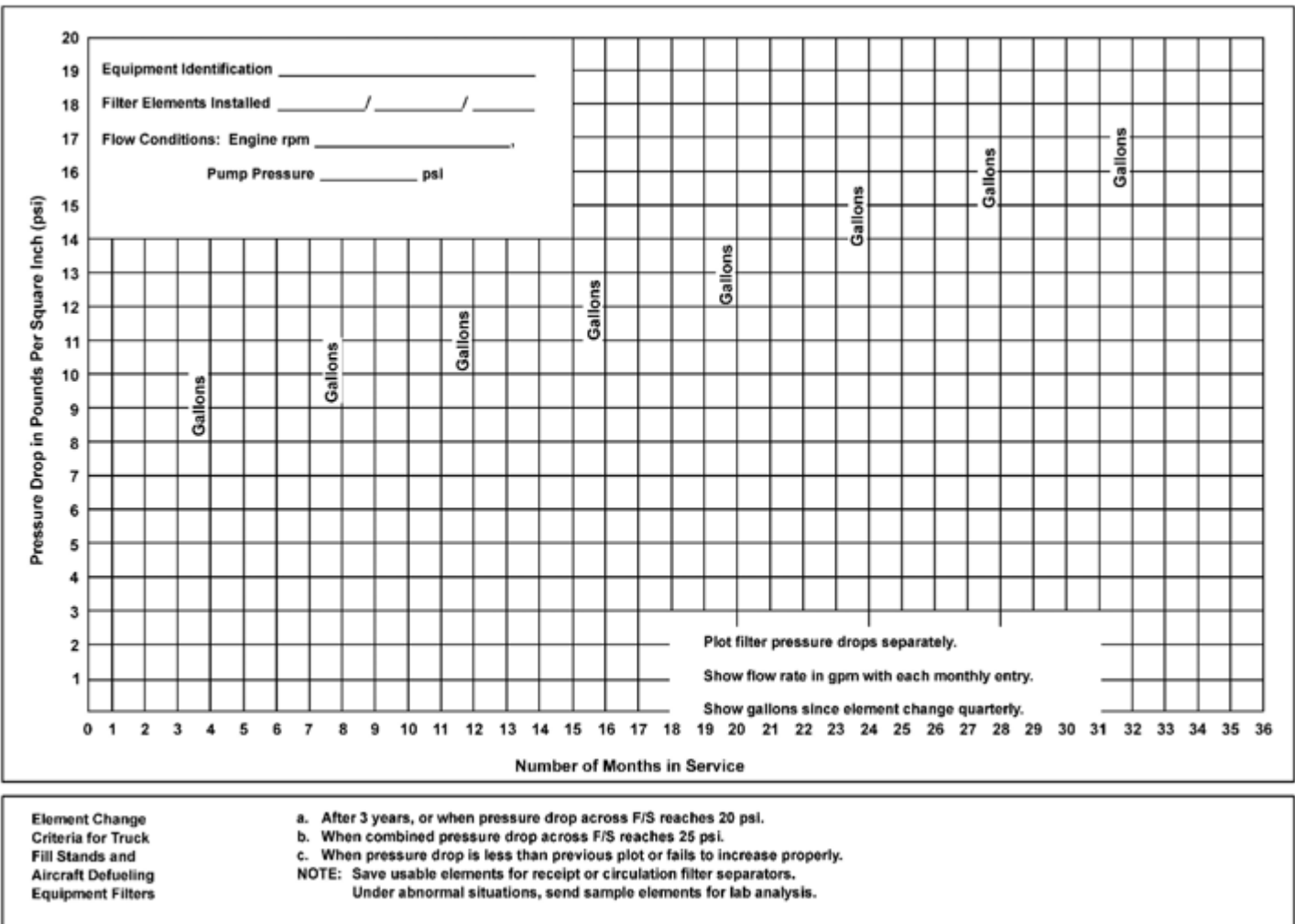
Records shall be retained as specified in the following schedule:

1. Periodic, annual and special reports — 2 years.
2. Completed daily checklists — 1 month.
3. Completed weekly/monthly checklists — 6 months.





Figure 13-6. Filter/Separator Pressure Drop Graph



Rev. 01-7006





Figure 13-7. Daily Storage and Distribution Facilities Checklist

DAILY STORAGE/DISTRIBUTION FACILITIES CHECKLIST			
Facility		Product	Date/Time
Line	Item	Initial	Remarks
1	Buildings: Condition/Serviceability		
2	Grounds: Vegetation/Hazards		
3	Firefighting Equipment (in place)		
4	Security Lighting/Fencing/Gates		
5	Berm Areas: Vegetation Control Drains Free, Closed and Locked		
6	Tanks: Last Inspected/Cleaned (date)		
7	Piping and Joints		
8	System Markings: MIL-STD-161		
9	Valves: Operation/Lubrication		
10	Pumps: Noise, Vibration, Overheating		
11	Filters: Drain, DP Reading, Chg Date		
12	Meters and Gauges: Calibration Dates		
13	Receipt and Issue Hoses/Issue Point Pantographs: Storage and Protection		
14	Overfill Protection/Deadman Controls		
15	Relaxation Chambers (as applicable)		
16	Grounds; Condition/Continuity Checked		
17	Pits: Covers, Clean and Dry		
18	Emergency Showers and Eye Washes		
19	Electric: Switches/Controls/Lights		
20	Spill Containment Systems		
21	Pier Facilities (as applicable)		
COMMENTS: (Report all leaks, hazards and damage in the appropriate space.)			
Inspector:		Supervisor:	





PART IV

Aircraft Refueling In Tactical Units

Chapter 14 — Organization and Training for Tactical Fuel Operations

Chapter 15 — Quality Surveillance of Aviation Fuels for Tactical Units

Chapter 16 — Safety in Tactical Fuel Handling Operations

Chapter 17 — Tactical Fuel Systems and Equipment

Chapter 18 — Operating Procedures for Tactical Fuel Units

Chapter 19 — Maintenance of Tactical Fueling Equipment





CHAPTER 14

Organization and Training for Tactical Fuel Operations

14.1 ORGANIZATION

The effectiveness of any complex operation is dependent on a well structured organization with qualified and knowledgeable supervision. The cost of fuel, equipment, the hazards associated with fuel operations and the essential part aircraft refueling plays in flight operations are a few of the critical factors that shall be considered in the development of a Fuels Branch's Table of Organization (T/O).

Navy advanced base functional component fueling system operators shall comply with the standard shore activities' requirements for organization and training contained in [Chapter 8](#) of this NATOPS Manual.

Marine Corps units are urged to continue their T/O review process to ensure that personnel in adequate quantities and with sufficient grade structure, training, and seniority are available to responsibly operate tactical fuel systems and auxiliary equipment in response to maximum projected operational demands. Forward Operating Base (FOB) support methodologies, relative to type and numbers of aircraft to be supported, must also be considered.

The viable T/O should provide for enough personnel to handle increased workloads on short notice. Lengthening working shifts and non-standard duty sections, including stand-by duty section assignments, should be last-resort measures (recommended not to exceed 12 hours).

The commodity managers/functional heads (Fuels Officer [FO] and Fuels Chief [FC]) of integrated fuel operations shall:

1. Possess broad fuel background and experience (e.g., formal training and experience in the technical area of fuel operations and handling).
2. Be full-time primary assignments.
3. Carry delegated authority commensurate with responsibility.

Note

Reference to the FO and FC in this NATOPS manual parallel references to the FMO and AFMO in MIL-HDBK-844B(AS), respectively.

14.1.1 Responsibilities

The unit commander is responsible for receipt, storage, accountability, issue, quality surveillance, and environmental impact of petroleum products within FOBs. The preventive and corrective maintenance of all tactical fuel handling, storage, and delivery systems assigned to the unit are integral parts of this responsibility.

The FO discharges the unit commander's fuel responsibilities through the planning, directing, training, and supervision of a completely integrated fuel operation. This mandate shall be carried out in accordance with current directives.

Aircraft custodians are responsible for training personnel who are qualified nozzle operators and aircraft directors for aircraft refuelings and defuelings. The nozzle operator shall assist the refueler operator in handling the hose and nozzle prior to, and after the servicing of aircraft in order to minimize hose wear and nozzle damage due to dragging.

The Airfield Operations Officer is responsible for establishing priorities for aircraft fuel delivery services.





14.1.2 Duties of Personnel Refueling Aircraft

1. Pump/vehicle operator (one per pump). This person shall be a fully qualified operator from the local fuels organization (See [paragraph 14.2.2](#)). This person shall be positioned at the pump/deadman control and maintain a clear line of sight with the refueling point operator and nozzle operator. Duties include actual operation of the deadman control or pump.
2. Nozzle operator (one per aircraft). The pilot, crewchief, plane captain or trained fuels personnel performs this duty. The nozzle operator shall be fully trained and certified for refueling duties related to the specific aircraft type/model/series being refueled. (See [paragraph 14.2.3](#)). Duties shall include the performance of necessary aircraft refueling checks. The nozzle operator shall remain at the nozzle throughout the refueling and leave only to conduct necessary vent checks.
3. Refueling point operator (one at each refueling point). Duties include zeroing the meter, grounding the aircraft, ensuring the nozzle operator has bonded the nozzle to the aircraft prior to refueling, assisting in nozzle hook-up, manning the fire extinguisher during actual refueling operations, chocking wheels (if cold refueling assault aircraft), and completion of required paper work.
4. Line NCO (one every two points). Duties include pre-operational fuel systems checks and monitoring the overall safety procedures while aircraft are in the FARP area.
5. Fire Watch/Fire Extinguisher operator (one per aircraft). The supported squadron shall provide a firewatch/fire extinguisher operator for mobile cold refueling/defueling operations.

Note

The Airfield Operations Officer will coordinate with tenant squadrons to provide fire extinguisher and nozzle operators for transient aircraft.

Refer to the MOS Manual and associated Individual Training Standards for a detailed discussion of the various specific duties of the FO, FC, and other personnel involved in fuel handling operations.

14.2 TRAINING REQUIREMENTS

14.2.1 General Training Requirements

It is essential to the safety of fuel handling operations that personnel be properly trained. Only those personnel possessing the ABF rating or qualified in accordance with the current MOS manual for MOS 1390, 1391, 3534 shall be involved in aircraft refueling operations from source to nozzle. These individuals will also require sustainment training in accordance with the Marine Corps Individual Training Standards (ITS) and this NATOPS Manual.

Additionally, personnel involved with aircraft refueling shall be trained via an informal course in which the applicable contents of this manual and MIL-HDBK-844B(AS) are taught. The course shall be developed to emphasize safety and procedural requirements contained in these manuals and how they apply to local situations. Personnel shall be required to demonstrate their acquired knowledge relative to their grade and/or position.

14.2.2 Refueling Vehicle Operator Certification

Mobile Refueler Operators (MOS 3534) shall carry a current U.S. Government Motor Vehicle Operator's Identification Card and comply with the requirements delineated in MCO P11240.7, the Marine Corps' Licensing Manual(s), MOS Manual, and Individual Training Standards System.

14.2.3 Nozzle Operators' Training and Certification

Nozzle operators shall be thoroughly trained and certified in accordance with the applicable directives for the type, model, and series of aircraft being refueled. This training shall result in the nozzle operator possessing a thorough working knowledge of the aircraft's fuel system including the following specific items:

1. Aircraft's ground refueling panel.
2. Precheck system.





3. Location and operation of any switches that control the flow of fuel into the various tanks of the aircraft.
4. Location of the aircraft's fuel system vents.
5. Mechanism(s) by which the pressures within aircraft tanks must be monitored (to prevent over-pressurization).
6. Mechanism(s) by which the tank loading status (e.g., full, partial, no load) can be monitored.





CHAPTER 15

Quality Surveillance of Aviation Fuels for Tactical Units

15.1 GENERAL REQUIREMENTS

The major objective of fuel handling personnel is to deliver clean, dry, 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. In addition, aircraft engine failure or poor performance may also be caused by incorrect fuel or by contamination through commingling. Refer to MIL-HDBK-844B(AS) for a detailed discussion of the various types of fuel contaminants, their effects on the using equipment, and their possible sources.

The quality surveillance of aviation fuels is a continuous process. Every action such as transferring product from one tank to another or short-term storage can introduce contaminants into the fuel. Sources of contamination must be recognized and eliminated. In addition, procedures must be in place to routinely monitor the quality of the fuel so that the presence of abnormal amounts of contaminants is identified and steps are taken to remove these contaminants.

All fuel quality control efforts performed at the refinery or time of fuel purchase are designated as “Quality Assurance.” All fuel quality control efforts performed after the fuel has been delivered to the Government are classified as “Quality Surveillance.” This chapter outlines the absolute minimum steps that shall be taken in order to:

1. Monitor the quality of the fuel being handled and delivered to aircraft.
2. Control and minimize the introduction of typical contaminants (water and sediment/particulates).

The detailed operating procedures contained in [Chapter 18](#) and the maintenance procedures of [Chapter 19](#) incorporate many of these monitoring and quality-surveillance steps.

15.2 AVIATION FUEL QUALITY SURVEILLANCE PROGRAM

All units that refuel aircraft shall establish a formal fuel quality surveillance program. Samples shall be taken from the refueling nozzle of each aircraft refueling point, mobile refueler, truck fill site, bulk receiving point, etc., and tested for water (by FWD, Manual Aqua-Glo or DFWD), sediment/particulates (by CCFD, Color Patch Test, or gravimetric test), and API gravity (by API hydrometers). Visual inspections shall also be taken for spot checks. All units shall record all test results in a log, similar to [Figure A-1](#) in [Appendix A](#), along with the date, approximate time, source (tank, refueler, filter/separator, refueling nozzle, etc.), and other appropriate information. This shall be done for visual as well as machine run tests. Such records shall be used to monitor equipment performance and to provide an audit trail.

The following paragraphs establish the minimum sampling and testing requirements for aviation fuels. They shall be treated as the minimum requirements and shall not preclude more frequent or extensive testing should contamination be suspected. MIL-STD-3004 contains analogous information regarding fuel sampling and testing requirements. In the event of a conflict between the requirements of this NATOPS Manual, MIL-STD-3004, and TM5-6630-218-1, this NATOPS Manual takes precedence.

15.2.1 Fuel Receipts

The following paragraphs contain the absolute minimum tests that shall be performed when receiving fuel at tactical sites.



**WARNING**

If for any reason it is suspected that the product being received has been significantly contaminated with other fuels, petroleum products, or other materials, a special sample shall be taken and a complete set of fuel specification tests shall be performed. Failure to identify and reject contaminated fuel can negatively affect aircraft safety-of-flight.

In addition to the routine samples that are immediately tested during fuel receipt, the operator shall obtain a 1-gallon retention sample that is representative of shipments received from other than internal unit sources. These samples shall be tagged, logged, and stored in an approved storage cabinet and retained for 60 days or until one of the following conditions occur:

1. The product represented by the sample is consumed.
2. The product becomes nonrepresentative of the sample held.

A shipment of fuel can be received even if it fails sediment/particulate or free water limits (e.g., 2 mg/L solids or 10 parts per million [ppm] water); however, precautions shall be taken to ensure the product meets requirements prior to issue into aircraft. Close attention shall be paid to filtering devices.

15.2.1.1 Fuel Received by Tank Car or Tank Truck

Ensure seals are intact and the numbers correspond to those on the shipping document if/when provided. Before connections with the receiving system have been made and fuel flow initiated, take an all levels sample from the delivery vehicle/tank and conduct the following tests:

1. Color.
2. Appearance.
3. API gravity.

If the product is clear and bright in appearance and the API gravity is within 0.3 degrees of the shipping document (DD Form 250, Material Inspection and Receiving Report, or delivery invoice as provided by external sources), receipt of the product shall be continued. A second sample shall then be taken downstream of the pumping and filtering equipment and tested for:

1. Sediment/particulates (visual).
2. Free water (visual).
3. Flash point (JP-5, JP-8, and F-24 fuels only).
4. FSII (turbine fuels only).†

†When testing capabilities are available.

15.2.1.2 Fuel Received by Bulk Transfer Line (e.g., AAFS)

Fuel received via bulk transfer lines shall be of the required quality prior to receipt. Prior to fuel flow being initiated, immediately take a source sample and conduct the following tests:

1. Color.
2. Appearance.
3. API gravity.





If the product is clear and bright in appearance and the API gravity is within 0.3 degrees of the shipping document (DD Form 250, Material Inspection and Receiving Report, or delivery invoice as provided by external sources), receipt of the product shall be continued. A second sample shall then be taken from the transfer line and tested for:

1. Sediment/particulates (visual).
2. Free water (visual).
3. Flash point (JP-5, JP-8, and F-24 fuels only).
4. FSII (turbine fuels only).†
5. API gravity.
6. Sediment/particulates (CCFD or gravimetric method).
7. Free Water (FWD, Manual Aqua-Glo or DFWD).

†When testing capabilities are available.

15.2.1.3 Fuel Received by Collapsible Fabric Drums or 55-Gallon Metal Drums

Fuel received by drum shipment shall be of the required quality prior to dispensing to aircraft or subsequent bulk storage. Upon receipt of collapsible fabric drums, take a sample upstream of the filter separator or an all-levels sample from a representative 55-gallon metal drum selected at random from each batch/lot and perform the following tests:

1. Color.
2. Appearance.
3. API gravity.

If the product is clear and bright in appearance and the API gravity is within 0.3 degrees of the shipping document (DD Form 250, Material Inspection and Receiving Report, or delivery invoice as provided by external sources), receipt of the product shall be continued. Before transferring to subsequent bulk storage, a second sample shall then be taken downstream of the pumping and filtering equipment and tested for:

1. Sediment/particulates (visual).
2. Free water (visual).
3. Flash point (JP-5, JP-8, and F-24 fuels only).
4. FSII (turbine fuels only)†.
5. Reid vapor pressure (AVGAS only)†.

†When testing capabilities are available.

15.2.2 Fuel in Collapsible Storage Tanks

Fuel tanks must be kept as clean and dry as possible. Recirculation and sampling shall be conducted daily. Fuel samples shall be taken from the nozzle and in accordance with [paragraph 15.2.3](#). Fuel stored in a collapsible tank which is not in continuous use shall be sampled monthly and laboratory tested for sediment/particulates and water.

15.2.3 Fuel Issued to Aircraft

Fuel in refueler trucks, fueling systems, or other dispensing equipment shall be recirculated (flushed) through the equipment/system's hoses and refueling nozzles and back to a tank each day prior to the first refueling of the day. After recirculation the fuel shall be sampled at the nozzle and visually tested for:

1. Color.





2. Appearance.
3. Free water.
4. Sediment/particulates.

At least once a week the samples from each refueling system or equipment shall be taken and tested for sediment/particulates and free water using the CCFD, color patch test, ASTM gravimetric test, FWD, Manual Aqua-Glo and/or DFWD, as appropriate and available.

Note

Two separate samples are required when running both a sediment/particulates and a free-water test to ensure correct quantity of fuel is available. Fuel that has been tested for sediment/particulates, free water, or FSII shall not be reused to run any other test since this practice could lead to inaccurate results.

Recirculation (flushing) and testing is required on any equipment/system that has not been used in refueling operations for 24 hours. In addition, daily random sampling from the refueling nozzle of equipment/systems and testing via appropriate test equipment and procedures for water and sediment/particulates are highly recommended.

15.2.4 Routine Verification Sampling and Testing

Each operating unit shall take a series of routine, duplicate verification samples to verify in-house testing procedures and equipment are working properly.

As an absolute minimum, each unit will draw two duplicate samples (four 1-quart bottles). Process each duplicate set of samples as follows:

1. Randomly select a refueling system/point, refueler truck, etc.
2. Extract two 1-quart samples, one immediately after the other, from the refueling nozzle of the system while it is being recirculated.

Note

If more than one set of duplicate samples is being taken at one time, appropriate steps must be taken to assure the source of each set of samples can be positively identified.

3. Test one of the samples using the units sediment/particulate testing equipment. Record the results in a log similar to [Figures A-2 and A-3](#).
4. Complete a fuel sample label (see [Figure A-4](#)) and attach it to the second (duplicate) sample. The results obtained from the units sediment/particulate testing equipment shall be entered in the remarks column on this label.
5. Ship the labeled, second (duplicate) sample to a supporting/regional fuel testing laboratory (see Appendix B of MIL-HDBK-844B(AS) for a list of laboratories) for testing of the sediment/particulates (using the ASTM D 2276 gravimetric method) or FSII as indicated on the sample's label.
6. When results from the regional laboratory are received, enter them into the appropriate log next to the results obtained using the unit's test kit. Compare the two results on the duplicate samples to verify the accuracy of the test kit.

15.3 SAMPLING PROCEDURES

Proper sampling of petroleum products is as important to quality surveillance as proper testing. Improper containers and poorly-drawn or mishandled samples can cause meaningless, inaccurate, and misleading laboratory results.





Directions for sampling cannot be made explicit enough to cover all cases. Judgment, skill, and experience should supplement any group of instructions. Consequently, personnel assigned to take samples shall be trained, experienced, competent, and conscientious. The responsibility for taking and preparing samples shall not be lightly delegated.

This section provides general information on petroleum sampling techniques and practices. For more detailed information and instructions including descriptions of the various types of samples common to the fuels community, consult ASTM Standard Practice D-4057.

15.3.1 General Rules

1. The sampler's hands shall be clean.
2. Sample containers, clear glass quart bottles or LDPE/HDPE plastic bottles, shall be meticulously cleaned (washed with laboratory glassware detergent [Alconox (NSN 7930-01-107-9169), Liquinox (NSN 7930-00-279-7089), Alcojet (NSN 7930-01-326-8099) or Fisherbrand Sparkleen] and water, rinsed with clean water, and oven- or air-dried). Wipe bottles clean with lint-free cloths (i.e., MIL-C-85043 Type II).

Note

Alcohol shall not be used to clean sample bottles.

3. Samples shall be representative of the product being sampled. Samples shall be taken with the system operating at normal flow rates and steady state. Samples drawn during static (no flow) conditions are not representative of the full fuel flow and will give false results. Samples shall be taken from a tank or drum with a proper sampling device, such as a thief or bacon bomb.
4. Samples shall be capped promptly, protected from light, and handled expeditiously.
5. Samples taken for shipment to shore laboratories shall be taken only in 1-quart glass sample bottles. Glass sample bottles for shipment to shore laboratories shall be filled to 1 inch below the cap.
6. LDPE/HDPE plastic bottles are authorized for use for the collection of sediment/particulate and free water fuel samples.
7. LDPE/HDPE plastic bottles shall be marked for the appropriate level (800 mL or 500 mL) and filled only to this mark.
8. Samples taken to test filter/separator efficiency shall be taken at the filter discharge.
9. Visual samples shall be taken in clear glass bottles only.

15.3.2 Sample Containers

The following fuel sampling bottles, containers, kits and safety cans are available through the supply system and are the only type authorized for the collection, retention, and submission of aviation fuel samples.

1. Kit, Fuel Sampling. A complete kit consisting of metal shipping container, cushioning material (inner-pack), and four 1-quart sample bottles, NSN 8115-00-719-4111.
2. Cushioning Material. Replacement top/bottom packing material for the above fuel sampling kit, NSN 8115-00-719-4825.
3. Replacement Kit. Replacement bottles and tags for the above fuel sampling kit, NSN 8115-00-717-8572.
4. Container, Fuel Sample. A 1-gallon, 24-gauge steel, epoxy resin lined fuel sample can suitable for the shipment or retention of fuel samples, NSN 8110-00-128-6819.
5. Drum, Shipping and Storage. A 5-gallon, 24-gauge steel, epoxy-lined fuel sample container suitable for shipment or retention of fuel samples, NSN 8110-00-400-5748.
6. Bottles, Glass, Clear. Twelve 1-quart clear glass bottles (without tags) suitable for taking visual samples and for shipping fuel samples to shore laboratories, NSN 8125-00-378-9994.





7. Bottles, LDPE/HDPE Plastic. Plastic bottles suitable for taking sediment/particulate and free water samples are available in two sizes:
 - a. 1000 mL, NSN 6640-01-300-3541 (6 bottles).
 - b. 500 mL, NSN 6640-01-461-1016 (12 bottles).
8. Container, Safety Can. Containers for the safe storage and transport of used fuel are available in two sizes:
 - a. 1 gallon, NSN 7240-00-177-4999.
 - b. 5 gallon, NSN 7240-00-178-8286.

15.3.3 Identification of Sample

All samples sent to a fuel testing laboratory shall be individually tagged with a label (see [Figure A-4](#)) containing the following minimum information:

1. The originating activity's name and address. A point of contact and phone number should be included.
2. Sample serial number (sampling activity's designation assigned to this particle sample) UIC-Julian date-sequential number.
3. Type fuel.
4. Date sample was taken.
5. Approximate time sample was taken.
6. Source of the sampling point (nozzle sample or refueler number).
7. Name of the person who drew the sample.
8. Classification of sample and tests required (see [paragraph 15.3.4](#)).
 - a. ROUTINE Monthly Verification (Insert locally determined sediment/particulate results in the (CCFD) space provided on the sample label. If this result has been determined by either the matched weight test or gravimetric test methods rather than by CCFD, draw a line through "CCFD." The B/2 results shall be inserted in the appropriate space if available.)
 - or
 - b. SPECIAL (list tests required and/or pertinent remarks. This is especially important when sending in special samples. The comments will assist laboratory personnel in determining what additional tests should be performed).
9. Identify in the remarks section where the regional laboratory reports are to be distributed. See [paragraph 15.7.5](#). Distribution lists for reports are found in [paragraph 15.7.3](#).

15.3.4 Sample Classification

All samples shipped to a fuel testing laboratory shall be classified either Routine Verification or Special.

15.3.4.1 Routine Verification Sample

Routine Verification samples are taken when no fuel problems or aircraft problems attributable to fuel are known or suspected.

15.3.4.2 Special Sample

Special samples are submitted for testing because the quality of the fuel is suspect either as the result of aircraft malfunctions or for other reasons. Special samples have the highest priority in handling, testing, and reporting.





15.3.5 Shipping Instructions

Samples are to be forwarded to appropriate testing laboratories by the most expeditious means. A listing of military petroleum laboratories is included in MIL-HDBK-844B(AS).

Wherever feasible, samples shall be delivered directly to the laboratory by special courier.

Samples to be shipped by military aircraft shall be packed in accordance with the requirements of the manual on Packing and Handling of Dangerous Materials for Transportation by Military Aircraft (AFM 71-4/TM 38-250/NAVWEPS 15-03-500/MCO P4030.19). The sampling kit listed in [paragraph 15.3.2](#) meets these requirements.

WARNING

New sample bottle caps shall be used for all new samples pulled with this sample kit.

15.4 FUEL TESTING STATION, TEST EQUIPMENT, AND METHODS

15.4.1 Fuel Testing Station

Once deployed, each tactical unit shall set up fuels testing equipment in a centralized, convenient, and reasonably protected (e.g., tent) location so that accurate test results can be obtained in a timely manner. In addition, each unit that refuels aircraft shall identify a fuel testing laboratory such as one of the regional laboratories listed in MIL-HDBK-844B(AS), which is capable of performing complete fuel analysis and is conveniently located for sample shipment and results reporting.

15.4.2 Testing Equipment

Each unit that refuels aircraft shall maintain the following aviation fuel test equipment. Local allowances shall be established for test equipment required to meet the minimum quality surveillance requirements of this manual.

15.4.2.1 Sediment/Particulate Testing Equipment

Each unit shall have one of the following instruments/or kits for evaluating the sediment/particulate contamination of fuel:

1. Combined Contaminated Fuel Detector (CCFD). This instrument is used to analyze the sediment/particulate contamination in a sample of fuel. Currently, the only CFD being procured is the CCFD, NSN 6640-01-013-5279, which includes a built-in FWD Viewer Kit. The regular CFD, NSN 6630-00-706-2302, is still available and may be used; kits are available to convert to a CCFD by adding a FWD portion as part of an upgrade/repair. Additional materials needed to conduct tests:

WARNING

The Combined Contaminated Fuel Detector (CCFD) electrical components are not rated for use with AVGAS and cannot be used for this application due to explosive hazard.

- a. Filter Element, Fluid, 0.65 micron — (NSN 6640-00-967-0500).
 - b. Filter, Wratten — (NSN 6630-00-849-5288).
 - c. Sample bottle.
2. ASTM D 2276 Gravimetric Test Method Equipment.





- a. Filtration apparatus (glass or stainless steel with proper grounding and bonding equipment).
 - b. Vacuum pump.
 - c. Membrane filters.
 - d. Sample bottle.
 - e. Thermal drying oven.
3. In-line sampling/color patch assessment method. See Marine Corps TM 01461B-12&P/1 or Army TM 10-6630-240-12&P for stock numbers (NSNs) of items included in the Aviation Fuel Contaminant Test Kit.
 - a. Monitor kit, fuel sampling.
 - b. Single filter monitor, millipore.
 - c. Matched weight monitor, millipore.
 - d. Aviation turbine fuel contamination standards.
 - e. Receiving can or vessel.

15.4.2.2 Free Water Detection Equipment

Each unit shall have the following instrument for evaluating the free-water content of fuel:

1. Digital Free Water Detector (DFWD), ASTM D3240 (NSN 6640-01-642-9285). This instrument is used to determine the free-water content of aviation fuels. Additional materials needed to conduct tests:
 - a. Detector Pad, Free Water (25 mm), 50 count, NSN 6640-00-235-3820.
 - b. Detector Pad Holder (25 mm), NSN 6665-01-642-9295.
2. Manufacturer calibration of NSN 6640-01-642-9285 shall be required by either the following:
 - a. The reported value is outside of the shuttle calibration standard range.
 - b. Within twelve months of manufacturers expiration date supplied with each unit.

15.4.2.3 Density Measurement Equipment

Each unit shall have the following API Thermo-Hydrometers in order to determine the API gravity of the fuel.

1. Thermo-Hydrometer, graduate 29- to 41-degree range, JP-5/8, non-mercury filled NSN 6630-00-242-9258.
2. Thermo-Hydrometer, graduate 39- to 51-degree range, JP-5/8, non-mercury filled NSN 6630-00-245-8376.
3. Thermo-Hydrometer, graduate 49- to 61-degree range, JP-4 and MOGAS, NSN 6630-00-245-8377.
4. Thermo-Hydrometer, graduate 59- to 71-degree range, JP-4, MOGAS, and AVGAS, NSN 6630-00-245-8374.
5. Thermo-Hydrometer, graduate 69- to 81-degree range, AVGAS, NSN 6630-00-245-8375.
6. Anton Parr DMA 35 digital density meter, NSN 6635-01-576-2591.

15.4.2.4 FSII Measurement Kit

Each unit shall have one of the following devices to determine the FSII content of aviation fuels.

1. B/2 Anti-Icing Test Kit or Fuel System Icing Inhibitor (FSII) Refractometer, NSN 6630-01-165-7133.
2. Gammon HB/2D Digital Refractometer, NSN 6650-01-633-0096.
3. MISCO PA202 Digital Refractometer, NSN 6650-01-615-4842.





15.4.2.5 Flash Point Test Equipment

A tester shall be used to determine the flash point of a fuel sample. It is absolutely essential that all activities possess this instrument since the flash point of any fuel removed from an aircraft must have its flash point tested in order to determine its disposition.

1. Pensky-Martens Closed Cup Flash Point Tester, NSN 6630-00-530-0987.
2. MARFLASH, NSN 6630-01-534-1774.

15.4.3 Test Methods

Instructions for performing the appearance or visual test, the backbone of any fuel quality surveillance program, are presented in [paragraph 15.5.1](#). Instructions and procedures for conducting tests with the equipment listed in [paragraph 15.4.2](#) are contained in either the operating manuals provided with each test instrument at the time of procurement or in the aviation test kit's supporting publication, TM 5-6630-218-10.

15.5 INTERPRETATION OF TEST RESULTS

To be acceptable for delivery to aircraft, aviation fuel must be clear and bright and contain no visual detectable free water.

WARNING

Personnel refueling aircraft shall cease fueling operations immediately upon detecting any departure from acceptable criteria. Refueling personnel shall inform the pilot, maintenance officer, or other designated person in charge as to the condition of the fuel delivered. Failure to identify and stop refueling operation can lead to loss of aircraft, pilot, and crew.

When off-specification fuel is identified, the refueling truck or other source of fuel will be placed out-of-service pending investigation and other corrective action that may result. The pilot, maintenance officer, or other person in charge, when notified that doubtful or contaminated fuel has been delivered to an aircraft, will take action to determine whether the aircraft shall be defueled and cleaned.

15.5.1 Appearance (Visual Test)

The test shall be conducted using a round, transparent, glass bottle, 1 quart to 1 gallon in size. The bottle shall be clean. The sample is first visually inspected for color and presence of foreign matter. The sample shall then be swirled to form a vortex. Particles coarse enough to settle will collect as sediment/particulates on the bottom of the bottle directly beneath the vortex.

A passing sample shall be "clear and bright," which means free of any cloud, emulsion, or readily visible sediment/particulate matter. Aviation turbine fuel (JP-4, JP-5, JP-8, F-24 or commercial Jet A or Jet A-1) should be colorless to straw-yellow. Aviation gasoline (AVGAS 100LL) is dyed blue. When any appreciable contamination is found, the test shall be repeated, paying particular attention to cleaning and rinsing the container prior to sampling. Also, if there is any question as to the quality of the fuel, both sediment/particulate and water measurements must be made using the aviation fuel test kit.

15.5.2 Sediment/Particulates

Solid contaminants such as rust and dirt can be held well below a level of 1 mg/L in a properly functioning fuel distribution system. If solid contaminants at aircraft dispensing points exceed 1 mg/L when tested by CCFD or gravimetric methods, investigate and take corrective action to improve fuel quality.

Field testing of turbine fuels using the in-line sampling method for sediment/particulate contamination should be conducted on a regular basis at the same sampling point to ensure accurate results over a sustained period. Follow the procedures delineated below:





1. If a contamination monitor (single membrane) shows a 2 or higher reading, run a second test with the matched weight monitor (double membrane).
2. If the difference is more than 2 numbers, do not use the fuel until a CCFD or gravimetric test has been completed.
3. If the top membrane is rated 5 or darker, the fuel must be tested using the CCFD or gravimetric test method before use, regardless of the color of the lower membrane.

WARNING

If solid contaminants exceed 2 mg/L or a 5 or higher color standard (any scale), delivery of fuel to aircraft shall be stopped and corrective measures completed prior to resumption of fueling operations. Loading aircraft with fuel with excessive contamination can result in a malfunction and/or subsequent loss of aircraft, pilot, and crew.

15.5.3 Free Water

Satisfactorily performing filtering devices will provide fuel containing less than 10 ppm of free water. Should the level of free water in fuel at an aircraft dispensing point exceed 10 ppm, a second sample shall be taken immediately to ascertain if the second sample confirms that the free water exceeds 10 ppm. If so, fueling shall be stopped until changes in procedure and equipment that reduce the free water to 10 ppm or below are effected.

CAUTION

During the receipt of fuel into a storage tank, if the other tests are satisfactory, but the sediment/particulate and/or free-water contamination is high, extra testing and surveillance shall be conducted downstream to assure that this contamination is reduced by filtration to acceptable levels before dispensing to aircraft.

15.5.4 FSII

FSII performs two important functions that help to avert significant safety-of-flight problems. First, it prevents the formation of water-ice in aircraft fuel systems, that can occur in certain susceptible aircraft. Second, FSII acts as a biostat preventing the growth of various microorganisms that can contaminate fuel systems, block filters, and promote corrosion.

The minimum level of FSII in fuel for USN/USMC aircraft requiring FSII to prevent water-ice formation is 0.03 percent. The minimum level of FSII in aviation turbine fuel for other US services' is 0.04 percent. The minimum level of FSII in aviation turbine fuel for foreign aircraft is 0.07 percent.

Tactical units have no means of raising the FSII level of their JP-5 (or other turbine fuel). FSII materials are mutagenic and considered to be dangerous in the neat state; however, they are safe once blended into the fuel. Injection of FSII is prohibited at the unit level. Refer to MIL-HDBK-844B(AS) for guidance on raising FSII level by commingling fuel between tanks.

If the FSII level falls below the 0.03 percent limit, the Fuels Maintenance Officer shall notify the appropriate Navy or Marine Corps squadron Commanding Officer (CO) or his/her designated representative, via the Air Officer, or as indicated by the local SOP. The applicable NATOPS Aircraft Flight Manual shall be consulted by the pilots for operating instructions, which will avoid resultant safety-of-flight problems.

Transient (USAF, USA, and visiting foreign military aircraft) crewmembers and pilots will be notified of low FSII (levels of 0.07 percent or less) so that they may consult their appropriate technical directives for special operating instructions necessary to avoid water-ice induced problems.



**WARNING**

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

Note

The B/2 Anti-Icing Test Kit Refractometer contains two FSII scales, one for each of the two different FSII materials currently in-use. All JP-5 fuel tested shall be assumed to contain the high flash point type of FSII material, Diethylene Glycol Mono Methyl Ether (DiEGME), which is read on the scale of the B/2 refractometer marked “JP-5” or “M.” Newer models of the B/2 refractometer may be only marked “DiEGME.”

15.5.5 Other Tests Results

The results of testing performed by supporting activities' laboratories shall be evaluated by comparison with the limits described in [Appendix B](#), which list the Deterioration Use Limits for Aviation Fuels. The limits in these two figures refer specifically to the acceptability of aircraft fuels for delivery to aircraft. The particular source for which the fuel is being removed and the one into which it is being loaded must be considered when applying these use limits; a limit on free water of 10 parts per million (ppm) maximum or 2 mg/L on sediment/particulates may not be applicable to a sample for a large shipment if subsequent cleanup in the fuel handling system can be anticipated.

Any unit that suspects other chemical contamination, deterioration during storage, or other unusual contamination or condition shall send fuel samples to an appropriate fuel laboratory (see Appendix B of MIL-HDBK-844B(AS)) for testing. Samples must be clearly labeled as discussed under identification of sample above with information about the suspected problem included in the remarks section.

WARNING

Failure to identify contaminated fuel and removal from use can result in reduced aircraft engine performance, malfunction, or catastrophic failure.

Inquires pertaining to the quality or testing of aviation fuels and lubricants may be addressed to COMNAVAIRSYSCOM (AIR-4.4.5), with a copy to the NAVSUP Energy Office.

15.5.6 Routine Verification Samples

Tactical units that use either the CCFD or gravimetric method for sediment/particulate determinations shall take duplicate routine monthly verification samples to compare test results obtained by the unit's in-house test kit(s) with those obtained by another fuel laboratory on the duplicate sample (see [paragraphs 15.2.4](#) and [15.3.4.1](#)). Some variation between the two test results is possible because of errors introduced by the shipment and storage of the duplicate fuel sample as well as differences in the test techniques. No action is necessary unless differences between the two results are significant (greater than 0.8 MG/L). When differences are significant, review the testing procedure, and submit and test more duplicate verification samples. If results are still unacceptable, contact AIR-4.4.5 at NAVAIR for further guidance.

Tactical units that possess FSII test kits shall also take duplicate monthly verification samples, test one at the tactical base and send one to a regional laboratory for verification testing. Results obtained by the tactical unit and the regional laboratory may vary by as much as 0.03 percentage points and still be considered acceptable. If greater differences are noted, review the procedure, recalibrate the instrument, and test additional verification samples. If results are still out of the acceptable range, contact AIR-4.4.5. If may be necessary to procure a new refractometer.





15.6 GUIDELINES FOR REQUESTING LABORATORY SERVICES

1. FMF units shall forward samples to a military laboratory in the geographic region, if practicable. See Appendix B of MIL-HDBK-844B(AS) for a list of laboratories.
2. Decisions about which laboratory to utilize shall be based upon laboratory proximity, capabilities, and responsiveness.

Note

Not all laboratories are available for regular recurrent testing on a no-cost basis.

15.7 REGIONAL LABORATORY TEST METHODS AND REPORTING

The following paragraphs provide instructions to regional laboratories that receive fuel samples from an FMF unit.

15.7.1 Routine Samples

Regional laboratories receiving samples from tactical units for routine fuel quality checks shall test the samples as requested on the sample label for one of the following properties using the listed ASTM method:

1. Sediment/Particulates, ASTM D 2276 or ASTM D 5452.
2. FSII content, ASTM D 5006.
3. Flash point, ASTM D 93 or D 6450.

Laboratories shall also note the presence of significant amounts of free water in the bottoms of sample containers. Laboratories shall not run free water determinations on routine samples since the free-water content of the fuel is severely affected by normal shipping and handling of the sample and results are meaningless.

Note

All JP-5 fuel tested shall be assumed to contain DiEGME.

15.7.2 Special Samples

Regional laboratories receiving special samples for testing shall conduct requested tests in accordance with methods authorized by the applicable fuel specification.

15.7.3 Reporting

Regional laboratories performing testing shall report the results to the following:

1. Original — Tactical unit submitting the sample.
2. One copy — Commander
Naval Air Systems Command (AIR-4.4.5)
22229 Elmer Rd., Unit 4
NAS Patuxent River
Patuxent River, MD 20670

15.7.4 Report Forms

Regional laboratories are requested to report results in a form similar to [Figure A-5 in Appendix A](#). If CCFD and/or B/2 results are reported by the tactical unit on the sample's label, regional laboratories shall include them with the results obtained on the fuel samples.





15.7.5 Distribution Lists for Reports

It is the responsibility of the tactical unit submitting samples to a laboratory to provide the laboratory with the desired distribution of reports in accordance with [paragraph 15.7.3](#) above.

15.7.6 Message Reports

When a “special” fuel sample has been tested and the results exceed the deterioration use limits of [Appendix B](#), the testing laboratory will report the findings as soon as possible by telephone to the aviation activity that submitted the sample. The telephone report shall be followed by a message report. During nonworking hours, the aviation activity's duty officer shall be notified of the test results. It is unnecessary to report test results via telephone or message for “routine monthly verification samples” which exceed the use limits for sediment/particulates; however, if the FSII content is found below the 0.03 limit a telephone and message report is required.

15.8 PROCEDURES FOR PREVENTING AND CONTROLLING CONTAMINATION

Contamination of aircraft fuel can be prevented only by the use of proper equipment and by carefully following proper operating procedures. Daily recirculation and fuel delivery/dispensing through a filter/separator that removes both water and sediment/particulates will help ensure fuel is clean and dry.

The proper care, operation, and maintenance of these systems are essential in assuring that only clean, dry fuel enters aircraft. As a minimum, operators should:

1. Observe the pressure drops at least daily across all filter/separators in accordance with applicable technical manuals.

Note

Pressure drop readings depend on the flow rate of the fuel through the filter. Meaningful readings can be obtained only if the system is operating at normal flow conditions during recirculation or flushing.

2. Take every precaution possible to prevent the introduction of any sediment/particulate matter (dirt) into the fuel. (See discussion in the MIL-HDBK-844B(AS).)
3. Install and maintain dust-tight caps or covers on all openings and connections, including refueling nozzles. These caps shall be removed only when item or system is in use.



To prevent a FOD hazard, component caps and plugs shall be attached either to the owning equipment or removed from the vicinity of aircraft refueling operations.

4. Brush away or remove any accumulated dirt or sand around tank flanges, manholes, etc. before opening/removing.
5. Never leave a storage tank, refueler truck, or other vessel open to the air any longer than absolutely necessary.
6. 55-gallon metal drums shall be checked for leaks and those found defective should be segregated for determination of usability. Drums shall be stored by batch number, and issued on a first-in, first-out basis. Drums should be placed horizontally (on sides) in rows, butt-to-butt, with bungs and vents positioned horizontally and facing outward. Drums should not be stacked more than three high. Drums stored outside should be positioned and placed on dunnage with proper blocking and bracing as necessary. AVGAS drums shall be covered or shaded to minimize environmental impacts and maintain product quality.
7. Do not operate any fuel handling equipment unless all filters, strainers, screens, and nozzle spout caps are properly installed and in place.





8. Never remove any filter, strainer, or screen for any purpose except cleaning or maintenance. Always replace filter or screen immediately after cleaning.
9. Observe and report any unusual accumulations of matter in nozzle screens to the FO/FC.
10. Observe water that is drained from refueler and filter/separator sumps. It should appear clean. Report any unusual accumulation of foreign matter/sediment/particulates to the FO/FC.
11. Drain (strip) and check all refuelers, tanks, filter/separators, and equipment provided with manual drains daily.
12. Circulate stagnant product in refueling equipment to remove condensate and sediment/particulate contaminants from lines, hoses, and nozzles prior to aircraft issues. This is mandatory for any refueling equipment that has not been in use for a period exceeding 24 hours. Minimum circulation time must be determined locally for each piece of equipment depending on its configuration and size as well as fuel flow rate. Allow sufficient time for the fuel in the piping and hose(s) downstream of the fuel filter/separator to be completely replaced by clean, dry fuel.
13. Ensure regularly scheduled maintenance is properly performed in accordance with applicable Technical Manuals and Directives.
14. If Federal/State/local environmental protection laws allow, keep refueler tanks filled when not in use or when no defueling is anticipated.
15. Never use the same system/equipment with a different fuel until all equipment has been properly purged.
16. Check fuel product markings on each separate piece of equipment for agreement before initiating any fuel transfer operation.
17. Never load or carry two different aviation fuels in one refueler.
18. Use separate hoses and equipment for each product.
19. Report and investigate any suspected contamination or any other unusual accumulation of foreign matter. The FO shall be responsible for initiating investigations and formulating corrective actions.
20. Report and correct any leaks.
21. Never use equipment configured solely as a defueler for refueling aircraft.
22. Use padlocks to secure manhole covers on items such as refueler trucks and SIXCON tank modules.





CHAPTER 16

Safety in Tactical Fuel Handling Operations

16.1 INTRODUCTION

This chapter contains safety procedures and requirements that are either general in nature and therefore not covered by the other chapters of this manual or are extremely important and repeated here for emphasis. Safety requirements emphasized in U.S. Marine Corps Technical Manual, TM-3835, have been incorporated in this chapter. Any departure from the procedures of this chapter may adversely affect the overall safety of the operation being performed.

Although the procedures and requirements contained in this manual are as complete as possible, they are no substitute for thorough knowledge of aviation fuels and their inherent characteristics and dangers. All aviation fuels personnel shall therefore be completely familiar with the information contained in MIL-HDBK-844B(AS), Technical Manual TM-3835, and equipment associated publications/directives. Refueling personnel can best avoid or correct unsafe situations by knowing and understanding aviation fuel hazards.

The development of safe and efficient fuel handling and aircraft refueling procedures is a continuously evolving process. Therefore, Standard Operating Procedures (SOPs) governing fuel handling operations in a field environment shall be published and reviewed annually.

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 is the investigation of field accidents or problems. Therefore, it is extremely important that knowledgeable personnel be involved in accident investigations, especially whenever explosions or fires have occurred. Units should therefore request the assistance and participation of experts whenever major fuel related accidents are being investigated to ensure correct conclusions are drawn. NAVAIR and the NAVSUP Energy Office can assist in the identification of appropriate experts.

16.2 ELIMINATING SOURCES OF IGNITION

16.2.1 Reducing Electrostatic Charges

WARNING

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

One of the primary sources of ignition is static electricity.

To ensure the safe relaxation of static charges relevant to fuel operations, all units shall:

1. Prohibit the top loading or splash filling of any rigid fuel vessel (e.g., MK970, or SIXCON fuel tanks).
2. Refill filter vessels slowly whenever they have been drained.
3. Keep tanks free of foreign objects that may become unbonded charge collectors (e.g., small conductive objects that can be floated by foaming fuel).
4. Always electrically bond the refueling equipment to the aircraft or truck into which the fuel is being loaded.



**Note**

All static electrical grounding points used for grounding aircraft during refueling (hot or cold) shall be tested after establishing the refueling point and checked as required to ensure a 10,000 ohm or less resistance. Aircraft-refueling points shall be tested as required, or when any change occurs in the status of the grounding point (movement of grounding rod, change of static grounding reel, etc.), to ensure a 10,000 ohm or less resistance is maintained. If testing equipment is unavailable, refer to MIL-HDBK-274 and NAVSEA OP5 Volume III for grounding procedures.

5. Ground for all hot refueling operations.
6. Bond refueling nozzles to the aircraft or truck into which the fuel is being loaded using a separate bonding pig-tail before tank caps are removed. This is absolutely critical for overwing (gravity) refueling nozzles since this is the only way to ensure metal-to-metal contact between the refueling nozzle and the aircraft throughout the refueling operation.
7. Inspect bonding and grounding cables, clamps, and plugs daily basis.
8. Check the electrical resistance of cables and pig-tails monthly. Replace if defective.
9. Do not conduct fuel operations when electrical storms are within 5 miles.
10. Remove refuelers from aircraft parking areas during electrical storms.
11. Ground all individual components that require grounding (3" meter, pump, filter-separator, etc.).

Note

All individual components requiring grounding that are in place for more than a 10-day period shall be tested to ensure a 10,000 ohm or less resistance is maintained. Component grounding points shall be tested monthly or when any change occurs in the status of the grounding point (movement of grounding rod, change of component, grounding cable, etc.) to ensure a 10,000 ohm or less resistance is maintained. If testing equipment is unavailable, refer to MIL-HDBK-274 for grounding procedures.

12. When providing grounds for use by mobile refueling equipment (MK970, SIXCON, etc.) for the purpose of refueling aircraft, individual verification of each separate aircraft grounding point is not required. Instead, a generalized verification shall be conducted in the geographical location (FARP site, FOB, etc.) to ensure a suitable ground (less than 10,000 ohms resistance) can be maintained. Mobile refueling equipment parking area grounding points shall be checked prior to being used and verified weekly or when any change occurs in the status of the grounding point.
13. When servicing aircraft, equipment/vehicles, or transferring fuel from drums, the same grounding/bonding procedures used for aircraft fuel servicing apply.

16.2.2 Eliminating Other Sources of Ignition

To prevent or eliminate sources of ignition, units shall:

1. Prohibit fuel personnel from wearing shoes that have nails or other metal devices on the soles.
2. Advise fuel personnel not to carry or wear loose metal objects, such as knives or keys.
3. Check the exhaust piping on mobile refuelers daily to ensure holes, cracks, or breaks do not exist.
4. Prohibit smoking, spark or flame producing items, open flames, or hot work within 50 feet of any refueling operation.
5. Defer all repair work on fueling equipment during fuel handling operations.





6. Avoid introducing lights (except approved safety lights for use in hazardous locations) into any compartment or space where fuel or flammable vapors may be present. (API has determined that ordinary commercial two-and three-cell flashlights, using carbon zinc dry cell batteries, may be used safely around flammable fuel/air mixtures. Tests have proven them incapable of igniting vapors, even if accidentally dropped or the light bulb is crushed.)

WARNING

Always assume that fuel vapors (in a tank or above a pool of fuel) are in the flammable range (i.e., proper fuel-air mixture to ignite).

7. Prohibit fuel personnel from carrying “strike anywhere” matches or cigarette lighters around fuel systems/equipment.
8. Ensure no repair or maintenance work is being conducted on the aircraft before starting the refueling or defueling operation.
9. Ensure liquid oxygen (LOX) operations are not being performed and LOX handling equipment are not located within 50 feet of fuel operations.
10. Be certain that aircraft radar and all unnecessary radio equipment is switched off before refueling or defueling is begun. If it is necessary that equipment be warmed up prior to an immediate launch, be sure that it is not transmitting. The only exception to this rule occurs during hot refueling. Hot refueling operations require the pilot to keep in radio contact with the tower at all times.
11. Prohibit aircraft fuel handling operations within 300 feet of ground radar equipment.
12. Equip all internal combustion engines operated within 50 feet of fuel handling operations with spark arresting type mufflers.
13. Do not start or stop any engine, regardless of its configuration, within 50 feet of a fueling or defueling operation. This prohibition includes aircraft being serviced and adjacent aircraft, as well as ground support equipment. The starting or stopping of an engine within 50 feet of a fueling or defueling operation is sufficient cause for the operator to immediately shut down the fuel pump.
14. Open valves slowly to avoid or minimize any splashing in tanks.
15. Conduct open port/overwing refueling only as a last resort and then only if operational necessity or aircraft design dictates.
16. Unless rapid turnaround of aircraft is required, hold hot refueling operations to the absolute minimum possible. Studies show that cold refueling operations are inherently safer, are more cost-effective (less FARP operations), and are therefore preferred to hot refueling.
17. Ensure personnel do not become entangled working in and around fuel handling equipment.

16.3 REDUCING OR CONTROLLING VAPOR GENERATION

In order to help prevent fires by reducing or controlling vapor generation, units shall:

1. Avoid handling aviation fuel in open containers.
2. Avoid refueling, defueling or draining aircraft, or conducting fuel handling operations in a hangar or confined area, except for the removal of water and the extraction of samples from aircraft low point drains. This does not apply to structures specifically designed for these operations.
3. Keep all fuel containers, such as aircraft fuel tanks or vessels, closed except when necessary to open for actual operation.
4. Avoid spilling fuel during fuel handling operations.





5. Take immediate action to clean up any spills that occur.
6. Properly dispose of oily waste or rags (in self-closing containers) immediately after using.
7. Never drive or move a refueler or defueler with a leak in the tank, piping, or other equipment.
8. Report all leaks in any portion of the fuel systems to the FO/FC.
9. Treat empty, or apparently empty, cans or containers that formerly held aircraft fuels as though they still contain fuels. These containers still contain vapors and are dangerous until vapor-freed.
10. Be aware that fuel vapors are heavier than air and will collect in low places such as sumps and berms.
11. Never dispose of waste fuel in other than approved containers or fuel-water separators.
12. Never top load or splash fill tanks. (This does not prohibit overwing or open port refueling of aircraft that are configured for this operation.)
13. Keep all equipment and work areas neat, clean, orderly, and in good mechanical condition.
14. Ensure firefighting equipment and extinguishers are in good condition and readily available to the maximum extent possible.
15. Never use fuel as a cleaning agent.
16. Unless specifically designed for and operational necessity dictates, fuel containers (e.g., drums, collapsible 500-gallon, which contain fuel) shall not be loaded internally to aircraft or ground vehicles unless designed specifically for that purpose.
17. Keep non-vented fuel containers, such as drums, covered or shaded.

WARNING

AVGAS may form explosive air/vapor mixtures at normal ambient temperatures.

16.4 EXTINGUISHING FIRES

All fuel handling personnel should be aware of the basic principles involved in extinguishing fires as well as the equipment used. Fuel handling personnel should also make certain that appropriate firefighting equipment as depicted by authorized allowances is in good condition, and readily available whenever and wherever fuel handling operations are being conducted. For maximum effectiveness and safety, fire extinguishers must be operated in accordance with the specific procedures developed for each individual type. MIL-HDBK-844B(AS) contains a special section on fire extinguishment, which has been extracted from NAVAIR 00-80R-14, U.S. Navy Firefighting and Rescue Manual. All refueling personnel should receive fire extinguishing training initially and annually (sustainment training) thereafter.

WARNING

Use all fire extinguishers only for their intended purpose.

16.5 MINIMIZING HEALTH HAZARDS

Aviation fuels be handled with caution because of the obvious dangers associated with possible fires and/or explosions. Additionally, these materials, themselves, present a danger to the health of fuel handling personnel. These dangers are as equally important as those of fires and explosions even though they are not so well-known. MIL-HDBK-844B(AS) contains a detailed discussion of the health hazards of aviation fuels.

In order to minimize the health dangers, fuel handling personnel shall:





1. Avoid entering enclosed areas where fuel vapors are present.
2. Keep to an absolute minimum the amount of time spent breathing fuel vapors. Good ventilation of work space is essential.
3. Stay on the windward, or upwind, side of spills when it is necessary to remain in an area where a large spill has occurred.
4. Stay on the windward, or upwind, side when conducting fuel handling operations, where the formation of vapors is unavoidable, such as at a truck fill stand.
5. Stop the fuel handling operation and move to a fresh air location immediately if a feeling of dizziness or nausea occurs.
6. Avoid skin contact with liquid fuels and tank water bottoms that can contain a high concentration of FSII. If fuel or water bottoms do contact the skin, wash with soap and water immediately.
7. Never wash hands in fuel.
8. Dilute with water, then remove fuel-soaked clothing or shoes at once.
9. Wear eye protection and clothing that leaves a minimum amount of skin exposed during refueling operations.
10. Use footwear that completely covers the feet in order to provide protection against fuel spills and fires. Shoes made of fabric or other absorbent materials are not acceptable.

16.6 CONFINED SPACES

Personnel entering or working in or around confined spaces exposed to fuels and fuel vapors will encounter potential hazards such as:

1. The lack of sufficient oxygen.
2. The presence of flammable or explosive vapors.
3. The presence of toxic vapors and materials.

These hazards may not always be readily apparent, detectable by odor, or visually obvious to persons entering or working within such spaces. Therefore, all confined or enclosed spaces such as fuel tanks and refueler/truck tanks will be ventilated and tested prior to entry. To minimize risk, fuel handling personnel shall:

1. Never enter a tank or vessel that has contained any fuel until all safety precautions have been followed and then only with experienced, knowledgeable supervision present.
2. Use a blower-type mask or positive pressure hose mask, boots, and gloves if it is necessary to enter a confined area where fuel vapors may be present.

More definite information regarding the hazards of confined spaces, hazardous environments, and gas-free engineering is contained in NAVSEA S6470-AA-SAF-010, U. S. Navy Gas-Free Engineering Program Technical Manual and the NAVOSH Program Manual 5100.23B. All personnel shall comply with the applicable policies and procedures specified in these manuals.





CHAPTER 17

Tactical Fuel Systems and Equipment

17.1 GENERAL REQUIREMENTS

This chapter establishes the minimum requirements for aviation fuel handling equipment utilized by deployable FMF units engaged in the refueling of aircraft.

17.1.1 Filtration Requirements

All units that refuel aircraft must pass the fuel issued to aircraft through a minimum of two fuel filtration systems (filter/separator). Filtration equipment generates static electricity; therefore, all refueling systems must reduce static electrical charges to acceptable levels prior to loading on aircraft.

Note

For tactical systems, inbound filtration may be considered one of the two required fuel filtration systems.

17.1.2 Maximum Refueling Pressure

All aircraft pressure refueling systems must limit the maximum pressure (steady flow conditions) at the aircraft's adapter to 55 psi measured at the sample port of the refueling nozzle. During the last few seconds of a refueling operation the aircraft's internal tank shut-off valves close, creating an instantaneous pressure surge within the aircraft's fuel system. The pressure control methods in every refueling operation must be able to limit surge pressures to below 120 psi. All modern aircraft are designed, built and tested for refueling within these pressure limitations.



In systems such as TAFDS and HERS where the refueling pressure is controlled manually, the operator must be continuously vigilant of system pressure and react immediately to slow the pump whenever pressure approaches 55 psi. The pressure gauges used at the pumps of these systems are not sensitive enough to indicate the actual surge pressure occurring in the system. Whenever the operator actually observes pressures in excess of 55 psi, surge pressure in the aircraft's system may exceed the 120 design limit resulting in tank rupture.

Note

The 120-psi surge is instantaneous and cannot be accurately quantified by someone watching a pressure gauge. Specialized equipment is needed to measure a system's maximum surge pressure. Contact NAVAIR AIR-4.4.5.1 if such testing is needed.

17.1.3 Mobile Refueler Marking

All refueling equipment shall be clearly marked with the appropriate NATO Code Number contained in a rectangle as well as the common U.S. military designation. For example, JP-5 refueling trucks shall carry the following symbol as well the JP-5 designation:



**F-44**

A complete list of the NATO Code Numbers can be found in Annex C of NATO STANAG 1135.

Refuelers that are used as refueler/defuelers shall be marked with only the product code JP since the fuel will, in most cases, be a mixture of JP-5, JP-4, JP-8, F-24 and/or commercial jet fuels. No NATO Code Number is to be applied to such equipment.

In addition to these product identification markings, all aircraft refueling equipment shall be marked with the following:

FLAMMABLE
NO SMOKING WITHIN 50 FEET

The emergency shut-off switch for each system shall be identified with red letters, 2 inches in height.

Refuelers/defuelers/ground fuel vehicles shall be free of rusted areas, flaking paint, and running rust. When touch-up painting exceeds 20 percent of the unit surface, the entire unit should be painted.

17.2 COMMON REFUELING EQUIPMENT/COMPONENTS

The following paragraphs provide a general description and the minimum requirements of the individual components that make up all tactical and/or deployable refueling systems including mobile equipment. As a minimum, each refueling “system” described in [paragraph 17.3](#) below must contain at least one (except where noted) of each of the items listed in the following paragraphs.



The design and construction of certain pieces of equipment listed in the following paragraphs are especially critical to overall safety. For those items designated with a dagger (†), units shall use only those manufacturers' part numbers that have been tested and approved by COMNAVAIRSYSCOM.

17.2.1 Filter/Separators

The filter/separator is the primary device used to keep aviation fuels clean and dry. Filter/separators shall be placed downstream of any fuel source and upstream of all refueling points/nozzles within any fueling system/asset.

Each filter/separator vessel shall be outfitted with the following minimum accessories:

1. Manual water drain valve from the bottom of the water sump.
2. Air eliminator valve.
3. Differential pressure gauge with 1-psi graduations to adequately measure the pressure differential across the elements.

17.2.2 Relaxation Design

Relaxation chambers are not resident within most current tactical fuel systems; therefore, system layout/design must allow for at least 30 seconds of static relaxation time downstream of the filter/separator and prior to fuel entering aircraft or other recipients. This means that at the highest possible flow rate of the system, it will take more than 30 seconds for the fuel leaving the filter/separator to reach an aircraft (or truck) refueling nozzle.





17.2.3 Fuel Meters

Meters used for service such as fueling aircraft need not be the temperature compensating type found in fixed (shore-based) facilities. Tactical systems' meters are accurate only to within ± 5 percent, and calibrations are done by the operator in accordance with TM 3835.

17.2.4 Hoses and Couplings

All hoses and couplings used in tactical systems shall be in accordance with TM 3835.

17.2.5 Hose End Pressure Regulator†

Hose End Pressure Regulators are not resident within the Marine Corps tactical refueling systems at this time; however, there is an ongoing effort to add these items where needed. In the interim, the following standard applies: Fuel delivery to aircraft should not exceed 55 psi.

17.2.6 Aircraft Refueling Nozzles†

1. Single Point Refueling (SPR) nozzles that meet the requirements of SAE AS5877 are approved for use ([Appendix D](#)). A quick disconnect sampling connection shall be provided on the nozzle for taking fuel samples and for pressure checks.
2. Overwing nozzle (also referred to as “gravity” and “open-port”) — nozzles shall meet the requirements of MIL-N-87963. Overwing nozzles shall have a tube spout suitable to the type of fuel and aircraft being serviced. Each over-the-wing nozzle shall have a permanently attached flexible bonding wire of suitable length terminating with a plug type connector (a clamp- type connector may be used if it conforms to MIL-C-83413).

Nozzles may be interchanged on the same hose using the quick disconnect coupling. Nozzles shall be equipped with 60-100 wire mesh screen (0.25-0.15mm sieve) to trap particulates from the issue system. Nozzles shall have a dust cover in place at all times when not in use.

17.3 TACTICAL FUEL SYSTEMS/EQUIPMENT

Tactical fuel systems, or Forward Operating Base (FOB) support systems as they are also known, are collections of the refueling components described in [paragraph 17.2](#) above. These systems are designed to be flexible and air, mobile, or ship transportable. FOB support systems, which are used primarily to support tactical operations in and around expeditionary airfields of varying sizes, are available in the following main types or categories:

1. Tactical Airfield Fuel Dispensing System (TAFDS).
2. Helicopter Expedient Refueling Systems (HERS).
3. MK970 mobile refueling vehicles.
4. Navy Advanced Base Functional Components Fueling Systems (H-14K).
5. SIXCON tank and pump modules.
6. Flatrack Refueling Capability (FRC).

These systems should not be used in place of a fixed facility at any Navy or Marine Corps Station unless a mission oriented training or operational necessity exists. For stations/bases where the requirement does exist, a lined concrete or steel containment berm is recommended (or as detailed by local environmental regulations). Where a continual requirement is identified for the use of a tactical system to augment refueling operations, a request for a fixed facility is encouraged.

Each refueling system (e.g., TAFDS, HERS, MK970) shall include the following minimum components:

1. Filter/Separator.
2. Aircraft refueling nozzle — single point pressure refueling or overwing nozzle.





3. Sampling connection on the pressure refueling nozzle.
4. Bonding/grounding cables.

17.3.1 Tactical Airfield Fuel Dispensing System (TAFDS)

The TAFDS, as illustrated in [Figure 17-1](#), is used to service expeditionary airfields within FOBs (less air points). It is made up of self-contained components that can be hooked together with quick-disconnect camlocking fittings to receive, store, transfer, and dispense aviation fuels. The design concept of the systems is to meet numerous operational requirements by permitting flexibility in assembly layouts. It is capable of receiving fuel from the Amphibious Assault Fuel System (AAFS) or other sources if appropriate adapters are available. TAFDS is designed to dispense fuel to up to 12 refueling points simultaneously. The basic capacity of the TAFDS is 320,000 gallons when configured with four 50,000-gallon and six 20,000-gallon collapsible tanks.

17.3.2 Helicopter Expedient Refueling System (HERS)

The HERS, as depicted in [Figure 17-2](#), is also composed of self-contained components that can be hooked together with quick-disconnect camlocking fittings to receive, store, transfer, and dispense aviation fuels. The HERS is designed for refueling helicopters at remote locations at the rate of 150 gallons per minute from 4 dispensing points. The HERS capacity is 18,000 gallons configured with three 3,000-gallon collapsible tanks and eighteen 500-gallon collapsible drums. The system may be tailored to increase or decrease capacity by adding or deleting tanks and accessories.

Figure 17-1. Tactical Airfield Fuel Dispensing System (TAFDS)

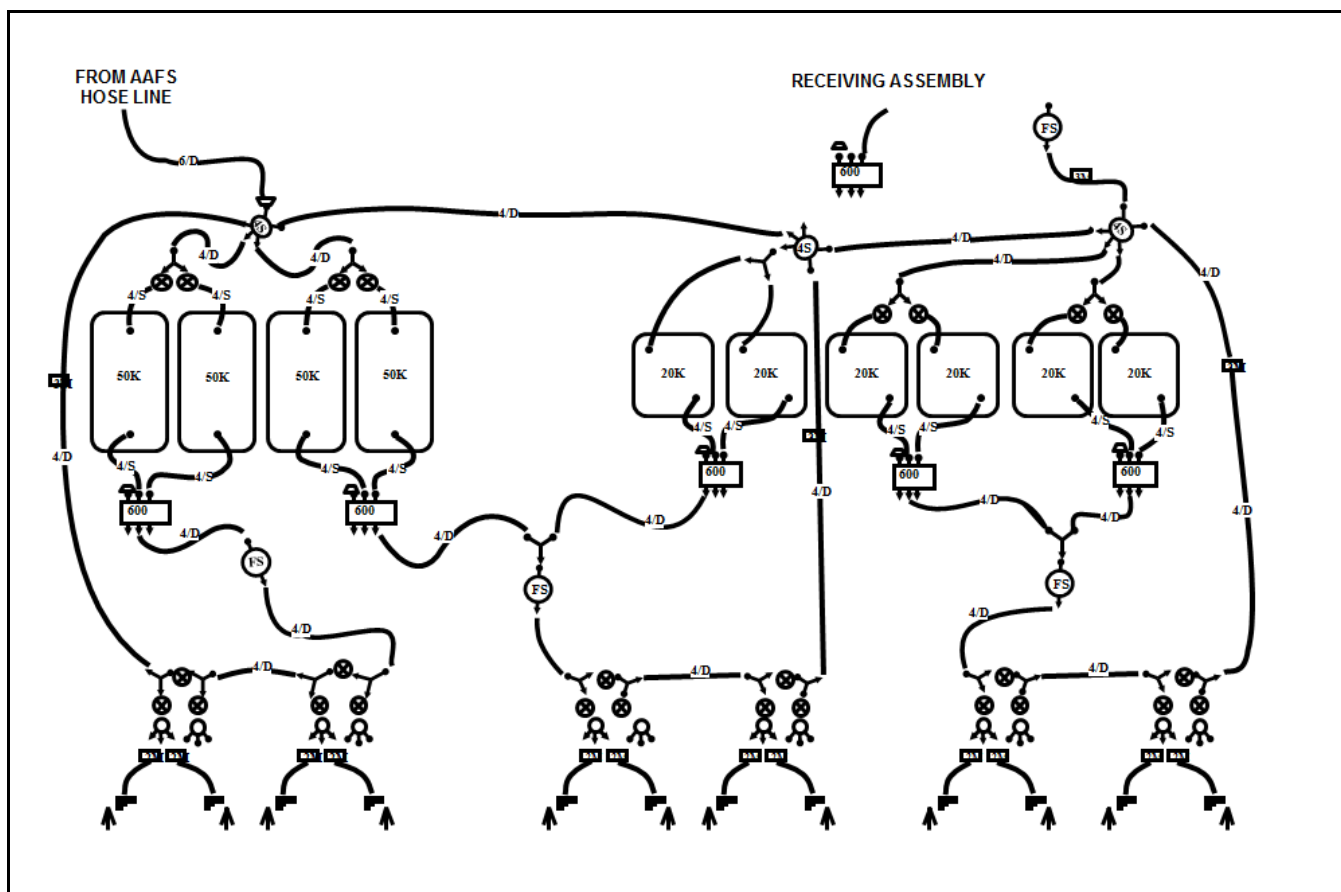
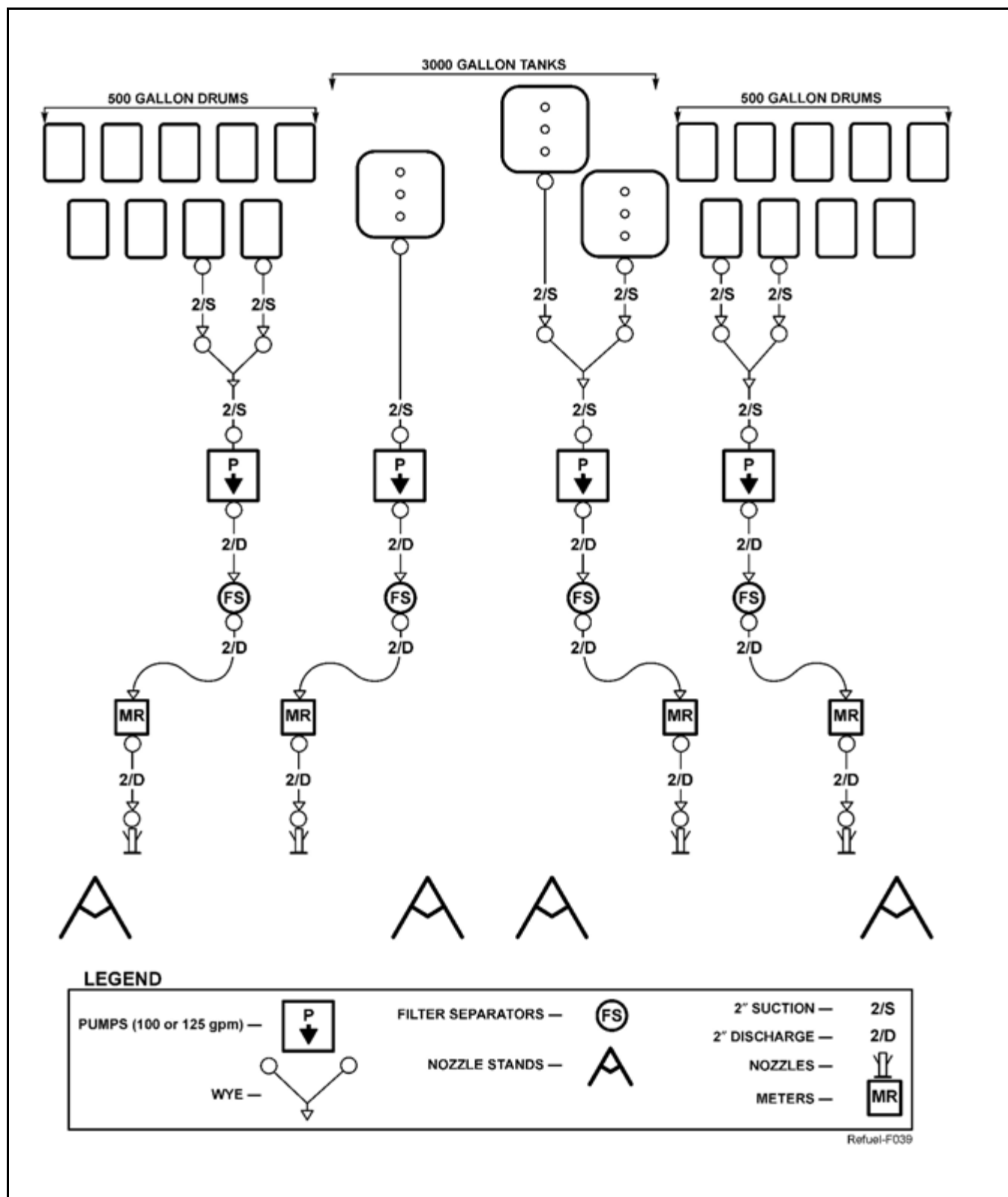




Figure 17-2. Helicopter Expedient Refueling System (HERS)





17.3.3 Navy Advanced Base Functional Components Fueling Systems (ABFC-H14K)

An ABFC-H14K, which is illustrated in [Figure 17-3](#), is a self-contained wheeled unit weighing approximately 6,000 pounds. It is designed to refuel aircraft at up to 350 gallons per minute. As outlined in [Figure 17-4](#), each unit contains all of the components required to safely refuel aircraft, bottom load trucks, or transfer fuel from one tank or bladder to another. Basic unit configuration includes diesel driven fuel pump, filter/separator, relaxation chamber, primary pressure control, deadman control, hose, hose reel, hose-end pressure regulator, and SPR refueling nozzle. Units are primarily designed to pump fuel from existing tanks or bladder systems; however, the cart's structure is designed to accommodate several collapsed bladders on top. Since these units possess all the requirements established for shore-based systems, ABFC-H14K operators shall follow the operating procedures and requirements contained in [Chapter 12](#) of this manual.

17.3.4 Mobile Aircraft Refuelers (MK970)

Mobile refuelers are used primarily for cold fueling operations.

Tactical refuelers shall meet the following minimum requirements:

1. Tank construction shall consist of one compartment only, with necessary baffles. Tank shall completely drain at low point without traps of liquid remaining in pockets. The tank shall be designed so that all portions are accessible for cleaning and maintenance.
2. Tanks shall be aluminum or stainless steel.
3. Tank top opening(s) shall be semipermanently secured with padlocks and opened for inventory purposes only, gauging prior to loading (field environment) and interior inspections and repairs. Manhole covers should incorporate a fusible plug or plugs, each equipped with fine screens to provide additional emergency vapor release.
4. Tank shall be configured for bottom loading.
5. The piping system including all hardware components shall be capable of dispensing fuel at rated flow.



The use of swing joints with Zerk grease fittings is prohibited, since they can contaminate the fuel with grease.

6. Aircraft fuel servicing vehicles shall have at least two fire extinguishers installed. Each extinguisher shall have an ANSI rating of not less than 20-B.
7. Tires shall be wide lug, wide groove tread. The tread shall not have narrow groove design in which small stones and foreign matter could become embedded and deposited on airfield surfaces. Recaps and slicks are not authorized for use on the front wheels when operating off-base.
8. The exhaust of all engines, including auxiliary engines, shall be equipped with a suitable spark arrestor.
9. Filter/separator.
10. Pressure and differential pressure gauges.
11. Meter.
12. Approved aircraft refueling hoses.
13. Dry break quick disconnect coupling.
14. Hose-end pressure regulator.
15. Approved aircraft refueling nozzles.



**Note**

Refueler/defuelers shall have two separate hoses — one that includes a hose end pressure regulator for refueling operations and one without for defueling operations.

16. Bonding cable(s).
17. Remote, hand-held deadman control.

For a more detailed discussion of the physical and functional descriptions of tactical fueling assets, refer to associated TMs, NAVAIRs, etc.

17.4 AIRCRAFT DEFUELING EQUIPMENT**17.4.1 Refuelers/Defuelers**

The most ideal and cost-effective method of handling nonsuspect defueled aviation turbine fuel is to reissue it to an aircraft. The opening of manholes during defuel operation is prohibited.

WARNING

Opening the manhole cover presents several dangers including the possible introduction of ignition sources into the flammable vapor space of the tank as well as contaminants into the fuel.

In addition to the requirements for refuelers, refuelers/defuelers shall meet the following minimum requirements:

1. Refuel/defuel trucks shall carry the markings, “JET FUEL/JP” in place of the normal markings (e.g., “JP-5 JET FUEL F-44” or JP-4 JET FUEL F-40”).
2. Defuel capability that passes fuel through the pump, filter/separator, relaxation chamber (fuel without SDA), and meter before it enters the tank.
3. Maximum defuel rate is 100 gpm.

17.4.2 Defuelers

These units are used for defueling only. Fuel placed in a defueler shall not be directly reissued into an aircraft since the fuel carried is suspect. Fuel in a defueler shall be sampled and tested to determine disposition. Defuelers will be clearly marked as such.





Figure 17-3. Navy Advanced Base Functional Components Fueling Systems (ABFC-H14K)

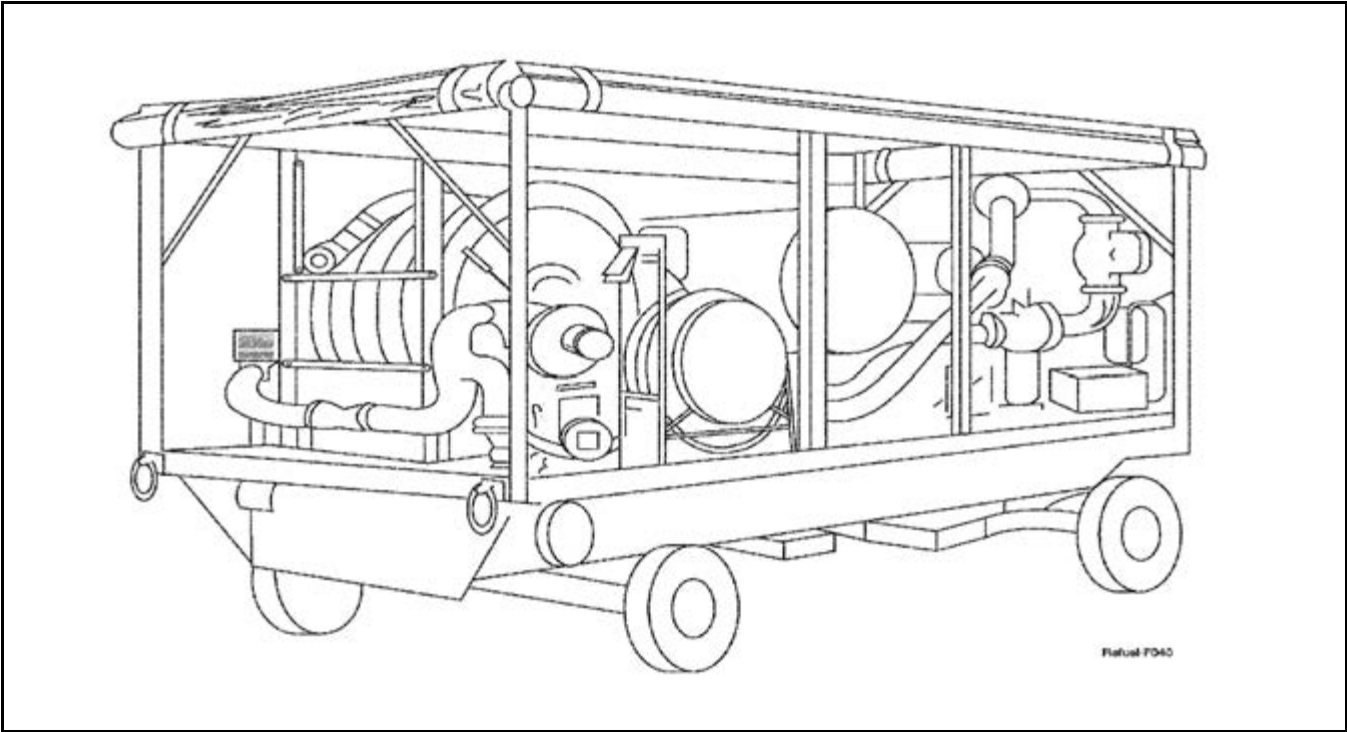
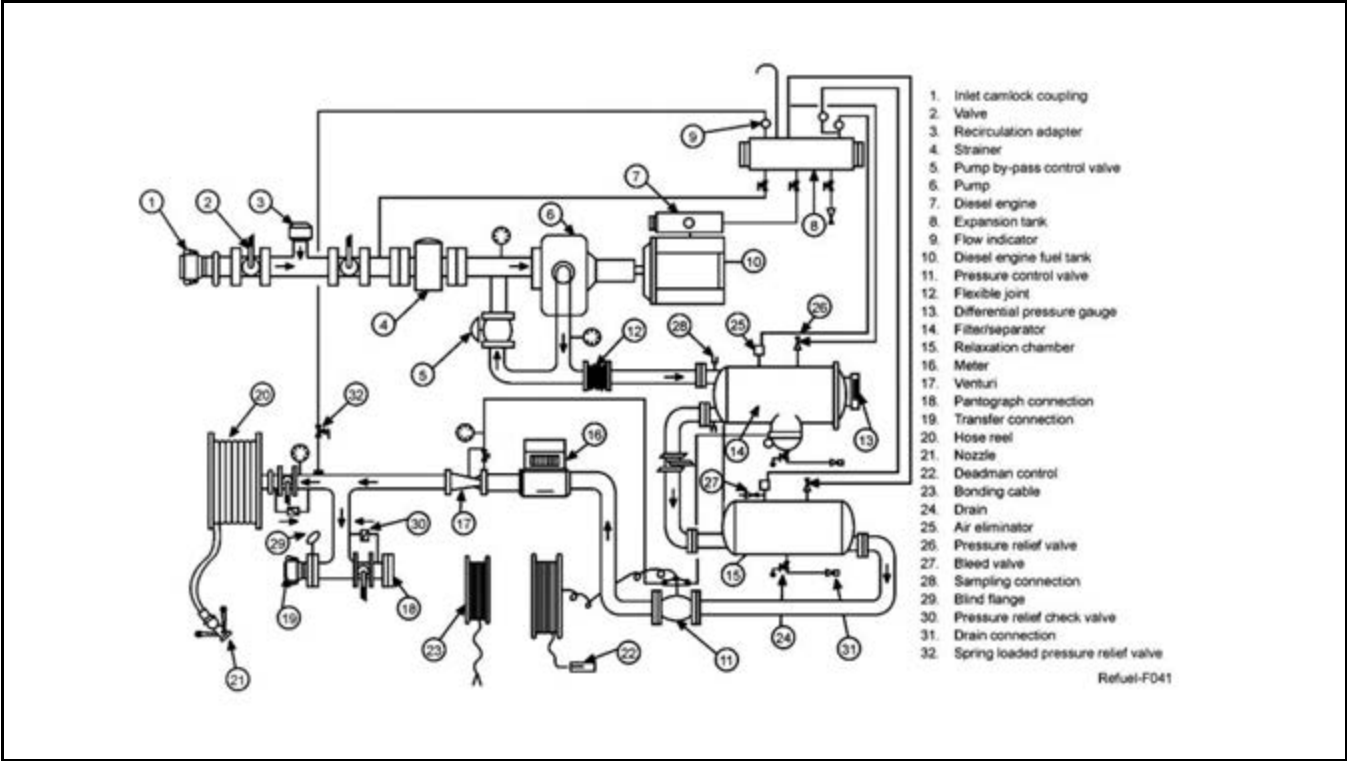


Figure 17-4. ABFC-H14K System Schematic





17.5 TRUCK PARKING AREAS

17.5.1 Condition of Truck Parking Areas

Each unit shall have adequate truck parking areas accessible by good roads. Both the parking area(s) and the access roads shall be paved and maintained in good condition. Parking areas shall be free from chuck holes and ruts that cause refueler damage and FOD.

17.5.2 Parking Area Requirements

Refuelers/fuel servicing equipment shall be parked in designated parking areas. Equipment shall be positioned so that it is free to exit its designated parking areas without requiring excessive backing or abnormal maneuvering to avoid structures such as buildings, hose lines, other vehicles, or other equipment. Units shall have sufficient truck parking spaces to allow:

1. A minimum lateral separation of 25 feet (measured center to center of truck) between trucks.
2. No trucks to be parked closer than 100 feet to any inhabited structure.
3. Separate entry/exit designed to facilitate one-way traffic patterns within the parking area.
4. Free and direct egress from the parking area of any truck at all times. No object or another truck may block or hinder the egress of any of the trucks parked in an area.
5. Security to preclude unauthorized unintended entry into the refueler parking area.
6. Security lighting (optional in a field environment).
7. Spill containment that will prevent the run-off of fuel in the event of tank rupture or major spill during loading operations. The type of containment used depends on the scenario (in a nonfield environment, concrete is preferred over asphalt).

Note

Ramps over containment curbs should not be any more than 2-percent grades (2.4 inches in 10 feet) in order to avoid refueler damage.

17.6 RECEIVING SITES

Fuel can be received by pipeline, barge, railroad tank car, tank truck, collapsible or metal drum shipment, or any combination thereof. Receiving stations are tailored to the method, quantities, and rates of fuel delivery. The primary method of aviation fuel delivery to the TAFDS is by hose line (pipeline) from the AAFS, truck, and in some instances, railroad tank car. Aviation fuel at this point should be received through a filter/separator or other appropriate filtration device. This is an essential requirement when fuel is received directly into the system charged with actual refueling of the aircraft. Communication equipment, if required, should be on-site during fuel-handling operations. Appropriate environmental protection shall be provided.

17.7 STORAGE TANKS

All collapsible tanks employed in the refueling of aircraft will be in accordance with appropriate military specifications. Tanks shall be maintained as aviation fuel (turbine fuels) only. Tanks previously used for ground fuels (e.g., diesel, Mogas, etc.) shall not be used for aviation fuels. Collapsible tanks or drums should not be used for long term storage (6 months or longer) of AVGAS.





CHAPTER 18

Operating Procedures for Tactical Fuel Units

18.1 INTRODUCTION

This chapter establishes minimum operating procedures to assure safe handling of aviation fuel. The operating procedures presented and discussed in this chapter are for systems/assets common to FMF units engaged in the fueling of aircraft. They include the basic steps that, for safety reasons, shall be performed with each fuel handling operation with particular emphasis on the fueling of aircraft. Any departure from the procedures of this chapter may adversely affect the overall safety of the operation being performed.

WARNING

Refueling personnel shall discontinue any fuel operation that does not appear to be progressing in a normal fashion (e.g., appears to be taking much longer than would normally be expected, or pressures are too high, etc.) or when a safety violation is in evidence and shall immediately notify the FO. Failure to recognize and terminate such an operation could lead to a catastrophic accident.

No deviation shall be made from the procedures contained in this chapter without the full cognizance of the FO. In those situations where abnormal fuel operations are required, the FO will determine whether or not to proceed with the proposed action. Assistance is available to the FO in accomplishing this task from NAVFAC (Code 00CE3), NAVAIR (Code AIR-4.4.5), the NAVSUP Energy Office (Code 70), and/or the TYCOMs (Code 44).

18.2 GENERAL OPERATING PROCEDURES

Fuel delivery equipment shall be operated by qualified fuel personnel and shall not be subcustodied to other than qualified fuels organizations. The following procedures are general in nature and shall be applied to all operations performed by each unit engaged in the fueling of aircraft.

Note

Forward Arming and Refueling Point (FARP) operations dictate that actual arming/refueling operations are conducted in close proximity. However, simultaneous arming and refueling operations are not authorized. Hot/cold refueling procedures outlined in this chapter shall be followed.

18.2.1 Spill Prevention and Control

Proper training of fuel servicing personnel is essential. Proper maintenance of the equipment is equally essential. Leaking or malfunctioning equipment shall be removed from service. Self-closing nozzles or deadman controls (where provided) shall not be blocked open or bypassed. Kinks and short loops in fuel hoses shall be avoided. In addition, a fuel spill/fire prevention drill must be conducted at least quarterly in accordance with 29 CFR 1910.

When a spill is observed, the fuel servicing shall be stopped immediately by release of the deadman control, by closing the nozzle handle, or by operation of the emergency fuel shut-off. The supervisor shall be notified at once and the operation shall not be resumed until authorized by the supervisor. Every fuel spill shall be investigated to





determine the cause, whether emergency procedures were properly carried out and what corrective measures are required.

18.2.1.1 Priming Spills

Pint-size spills, involving an area less than 18 inches in any dimension, require no emergency action during cold refueling operations; however, applicable personnel shall stand-by with a fire extinguisher until operations are complete and/or the aircraft departs. A spill or leak of any size is cause for terminating a hot refueling operation.

18.2.1.2 Small Spills

Other small spills involving an area of from 18 inches to 10 feet in any dimension shall have a fire guard posted, equipped with at least 1 fire extinguisher. Either absorbent cleaning agents (such as diatomaceous earth) or emulsion compound may be used to absorb the spilled fuel. Contaminated absorbent materials shall be placed in metal containers with closed lids until they can be removed and disposed of in accordance with local hazardous waste disposal procedures.



Fuel contact can adversely affect some types of surfaces (e.g., asphalt).

18.2.1.3 Large Spills

Covering an area greater than 10 feet in any dimension or over 50 square feet in area, requires handling by a supporting Spill Response Team. The team shall be summoned immediately and all other personnel evacuated to a safe distance. No one shall be permitted to walk through the liquid area of a fuel spill.

Note

The above spill size designators and corrective measures are general. Local regulations may be more stringent.

18.2.1.4 Spill Response

All fuel spills shall be reported immediately to the activity's Environmental Coordinator in accordance with the local spill contingency plan.

Note

- All fuel handling personnel shall be familiar with the local spill contingency plan.
- All FOs should be thoroughly familiar with OPNAVINST 5090.1.

18.2.2 Surge Pressure Control

All fuel handling procedures shall be designed to minimize surge pressure to below 120 psi. The following actions will help to accomplish this:

1. Close all valves slowly, particularly during the last half of the closure.

WARNING

Even during an emergency such as a hose or pipeline leak, valves shall be closed slowly. Rapid closing of a valve can create a surge pressure of sufficient magnitude to rupture hoses or equipment.





2. Pressure gauges installed in equipment must remain operational so operators can keep pressures within limits as valves are closed.
3. Start and stop pumps with recirculation lines opened, if there is such a perversion, then slowly close the lines.
4. In starting an operation, open the downstream valve first and work toward the pumping source.
5. In stopping an operation, reverse the above and close the upstream valve first.

18.3 REFUELING AIRCRAFT AT STATIONARY SYSTEMS (TAFDS AND HERS) WITH ENGINES OFF (COLD REFUELING)

Each unit shall record its direct refueling operations with a log similar to [Figure 12-1](#).

18.3.1 Pressure Refueling

18.3.1.1 Personnel Requirements

Cold refueling aircraft (static conditions) require a minimum of three people trained and certified in accordance with [Chapter 14](#) — a nozzle operator, refueling point operator and a pump operator.

18.3.1.2 Procedures

WARNING

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

Aircraft refueling tasks are to be performed in the following sequence and verified by the pump operator or the refueling point operator:

1. Recirculate (flush) the system hoses and take a fuel sample for quality-control checks as appropriate. (refueling point operator)

WARNING

Fuel shall be recirculated/flushed through the refueling hose and nozzle, and tested for contamination prior to refueling the first aircraft each day. Fueling shall not begin until acceptable results have been obtained (see [Chapter 15](#)). Failure to provide clean, dry fuel to aircraft can adversely affect safety-of-flight.

2. Check for hot brake conditions. (nozzle operator)

Note

Hot brake check is applicable to fixed-wing aircraft, or as required.

3. Position aircraft and chock it. (nozzle operator)



**Note**

- If an aircraft is towed into the refueling area during operation of the fueling system, the tow tractor shall remain attached to the aircraft and manned. This allows egress of the aircraft if an emergency situation arises.
 - Aircraft can taxi in and shut down, then cold refuel in accordance with these overwing procedures. Refueling operations at adjacent refueling points shall be suspended during engine shutdown and startup.
4. Pilot (or plane captain) shall secure all unnecessary electronic and electrical equipment not required for refueling.

Once a fueling evolution has commenced, the aircraft's electrical power status and connections shall not be changed until evolution has been completed or refueling has been stopped for an emergency (e.g., no aircraft engines or APU shall be started or stopped and external power shall not be connected, disconnected, or switched on/off).

WARNING

Changing the aircraft's electrical power status can create significant ignition sources.

Note

Switching off the F-35 28V battery does not provide a hazardous ignition source and is an acceptable procedure during refueling.

5. Verify that firefighting equipment is in the immediate vicinity of the refueling operation. (refueling point operator)
6. Attach a grounding cable to the aircraft from an established earth ground. (nozzle operator)
7. Zero the fueling system's meter or note the existing reading. (refueling point operator)
8. Pull out the refueling hose and place in proper position for refueling. (nozzle and refueling point operator). The refueling hose shall not pass underneath or around the aircraft to reach the refueling receptacle.
9. Remove refueling adapter cap from the aircraft and the dust cover from the nozzle. Inspect the face of the nozzle to ensure it is clean, and verify the flow control handle is in the fully closed and locked position. (nozzle operator)
10. (Plane captain/aircrew) Visually inspect the aircraft's adapter (receptacle) for any damage or significant wear. If any doubt about the integrity of the adapter exists, do not refuel.

WARNING

A worn or broken adapter can defeat the safety interlocks of the refueling nozzle permitting the poppet valve to be in the open position when removed from the SPR adapter and fuel to spray or spill.

11. Lift nozzle by lifting handles, align the lugs with the slots on the aircraft adapter and hook up to the aircraft by pressing the nozzle firmly onto the adapter and rotating clockwise to a positive stop. (nozzle operator)



**WARNING**

Nozzle must seat firmly on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system which can lead to a fuel spray or spill.

Note

Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. A defective or worn aircraft SPR can also be detected in this manner.

12. Upon receiving signals from nozzle operator/plane captain that hook-up has been completed and fueling operation is ready to begin, the refueling point operator will signal the pump operator to charge the system allowing fuel to flow to the nozzle.
13. When hose is fully charged, rotate the nozzle flow control handle to the FULL OPEN position. The handle shall rotate 180 degrees to ensure the poppet valve is fully open and locked. (nozzle operator)

WARNING

The flow control handle of the single point pressure refueling nozzle shall be placed in either of two locked positions — fully open or fully closed. The handle is not to be used as a flag to indicate fuel flow. Excessive wear on the aircraft's adapter and the fuel nozzle poppet will result if the handle is allowed to float in the unlocked position.

14. Once fuel flow has been established, exercise the aircraft's precheck system. (nozzle operator)

Note

- The precheck system simulates the completion of refueling by closing all of the tank shut-off valves within the aircraft. All fuel flow into the aircraft should stop within a few seconds to 1 minute of actuating the precheck system. On aircraft equipped with a fuel indicator, the primary means of detecting successful precheck is by observing the flow indicator on the aircraft to make sure that it stops. If the aircraft is not configured with a flow indicator, or if the aircraft flow indicator is inoperative, the only acceptable means of determining that precheck has been successful is to watch the fuel delivery system's flow counter (flow meter) to ensure it stops. A stiffening (or jerking) of the refueling hose or indication of a fueling pressure spike is not a suitable indication that precheck has successfully occurred (hose stiffening/jerking and pressure spikes can occur whenever one or more aircraft fuel tank refueling valves close).
 - Aircraft may be cold refueled if it fails precheck, but special procedures are required. This should be done only as an operational necessity. Refer to appropriate aircraft NATOPS Manual.
15. Fuel aircraft as directed by nozzle operator/plane captain. Nozzle operator/plane captain shall monitor aircraft vents, tank pressure gauge(s) and/or warning lights as necessary. (nozzle operator)
 16. When directed by the nozzle operator/plane captain, stop the flow of fuel. (Use deadman control if so equipped.) (refueling point operator)





17. Rotate the nozzle flow control handle into the OFF and fully locked position. (nozzle and verified by the refueling point operator)

WARNING

Failure to lock the flow control handle in the OFF position can contribute to a failure of the nozzle's safety interlock system and could result in a fuel spray or spill.

18. Disconnect nozzle from the aircraft adapter. (nozzle operator)
19. Disconnect the nozzle bonding plug/clip from the aircraft. (nozzle operator)
20. Disconnect the earth ground from the aircraft and stow away to its proper position. (nozzle and refueling point operator)
21. Stow the hose and return the nozzle to its proper position. (nozzle and refueling point operator)
22. Complete paperwork. (nozzle and refueling point operator)

18.3.2 Overwing/Open-Port (Gravity Refueling)

18.3.2.1 Personnel Requirements

Cold overwing gravity refueling of aircraft (static conditions) requires a minimum of three people trained and certified in accordance with [Chapter 14](#) — a nozzle operator, a refueling point operator and a pump operator. The refueling point operator will man the fire extinguisher during this operation. The Airfield Operations Officer will coordinate with tenant squadrons to provide nozzle operators for transient aircraft.

WARNING

Overwing refueling with the aircraft's engines operating is not authorized.

18.3.2.2 Procedures

WARNING

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

Aircraft refueling tasks are to be performed in the following sequence and verified by the refueling point operator:

1. Recirculate (flush) the system hoses and take a fuel sample for quality-control checks as appropriate. (refueling point operator)

WARNING

Fuel shall be recirculated/flushed through the refueling hose and nozzle, and tested for contamination prior to refueling the first aircraft each day. Fueling shall not begin until acceptable results have been obtained. (See [Chapter 15](#).) Failure to provide clean, dry fuel to aircraft can adversely affect safety-of-flight.



**Note**

Recirculate the refueling system and take samples with the SPR nozzle in place, then replace the SPR with overwing nozzle immediately before commencing open-port refueling operations.

2. Check for hot brake conditions. (nozzle operator)

Note

Hot brake check is applicable to fixed-wing aircraft, or as required.

3. Position aircraft and chock it. (nozzle operator)

Note

- If an aircraft is towed into the refueling area during operation of the fueling system, the tow tractor shall remain attached to the aircraft and manned. This allows egress of the aircraft if an emergency situation arises.
 - Aircraft can taxi in and shut down, then cold refuel in accordance with these overwing procedures. Refueling operations at adjacent refueling points shall be suspended during engine shutdown and startup.
4. Pilot (or plane captain) shall secure all unnecessary electronic and electrical equipment not required for refueling.
 5. Verify firefighting equipment is in the immediate vicinity of the refueling operation and manned. (refueling point operator)
 6. Attach a grounding cable to the aircraft from an established earth ground. (nozzle operator)
 7. Zero the refueling system's meter or note the existing reading. (refueling point operator)
 8. Pull out the refueling hose and place in proper position for refueling. (nozzle and refueling point operator)
 9. Bond the overwing nozzle to the aircraft. (nozzle operator)

WARNING

Always bond the nozzle to the aircraft before the fill cap is removed. This connection shall remain in place until the entire fueling operation is complete. Failure to bond nozzle and/or maintain contact can result in a dangerous static spark inside the fuel tank.

10. Remove refueling cap from the aircraft and the dust cover from the nozzle. (nozzle operator)
11. Insert overwing nozzle into the aircraft's refueling port and maintain metal-to-metal contact between the overwing nozzle and the aircraft's refueling port throughout the entire fueling operation. (nozzle operator)
12. Upon receiving signals from nozzle operator/plane captain that hook-up has been completed and fueling operation is ready to begin, refueling point operator signals the pump operator to charge the system allowing fuel to flow to the nozzle.
13. Nozzle operator shall squeeze the handle on the overwing nozzle to initiate fuel flow and fuel aircraft as directed by nozzle operator/plane captain. Nozzle operator/plane captain shall monitor aircraft vents, tank pressure gauge(s) and/or warning lights as necessary.
14. When directed by the nozzle operator, stop the flow of fuel. (refueling point operator)
15. Remove the nozzle from the aircraft. (nozzle operator)
16. Disconnect nozzle bonding plug/clip from the aircraft. (nozzle operator)





17. Disconnect bonding cable from the aircraft. (nozzle operator)
18. Disconnect earth ground from the aircraft and stow away to its proper position. (nozzle and refueling point operator)
19. Stow the hose and return the nozzle to its proper position. (nozzle and refueling point operator)
20. Complete paperwork. (nozzle and refueling point operator)

18.4 TRUCK OPERATIONS

18.4.1 Filling Mobile Refueling Equipment (e.g., Rigid Tanks)

18.4.1.1 Personnel Requirements

Filling of mobile refueling equipment from TAFDS or HERS is a two-man operation for equipment not having high-level alarms/shut-off control features. The vehicle operator acts in the capacity of a nozzle operator. The second person will be the refueling point operator, their duties include pump operation and recirculation.

WARNING

Top loading shall not be performed. This method of filling rigid tanks is extremely dangerous because of the highly flammable vapors and static charges produced.

18.4.1.2 Procedures

Applicable equipment shall be filled in the following sequence:

1. Recirculate (flush) the system hoses and take a fuel sample for quality control checks as appropriate. (refueling point operator)

WARNING

Fuel shall be recirculated/flushed through the refueling hose and nozzle, and tested for contamination prior to issuing fuel each day. Fueling shall not begin until acceptable results have been obtained. (See [Chapter 15](#).) Failure to provide clean, dry fuel can adversely affect safety-of-flight.

2. Position vehicle, turn off lights, place gear shift in neutral/park position, set parking brake, stop engine, and turn off all switches (except for necessary alarms, etc.). (vehicle operator)
3. Verify firefighting equipment is in the immediate vicinity of the loading operation. (refueling point operator)
4. Verify product and estimate the amount of product to be loaded. (vehicle operator)
5. Attach a grounding cable from the vehicle to an established earth ground. (vehicle operator)
6. Zero the refueling system's meter or note the existing reading. (refueling point operator)
7. Pull out the loading/refueling hose and place in proper position for loading. (vehicle operator and refueling point operator)
8. Attach bonding cable between the filter/separator and the tank to be loaded. (vehicle operator)
9. Remove loading receptacle cap from the tank/truck. (vehicle operator)
10. Visually inspect the tank/truck adapter (receptacle) for any damage or significant wear. If any doubt about the integrity of the adapter exists, do not refuel. (vehicle operator)



**WARNING**

A worn or broken adapter can defeat the safety interlocks of the refueling nozzle permitting the poppet valve to be in the open position when removed from the SPR adapter and fuel to spray or spill.

11. Remove the nozzle dust cover from the nozzle and inspect the face of the nozzle to ensure it is clean and verify the flow control handle is in the fully closed and locked position. (vehicle operator)
12. Lift nozzle by lifting handles, align the lugs with the slots on the tank/truck adapter, and hook up to the tank/truck by pressing it firmly onto the adapter and rotating clockwise to a positive stop. (vehicle operator)

WARNING

Nozzle must seat firmly on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system that can lead to a fuel spray or spill.

Note

Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. A defective or worn aircraft SPR can also be detected in this manner.

13. Upon receiving signals from vehicle operator that hook-up has been completed and fueling operation is ready to begin, refueling point operator charges the system allowing fuel to flow to the nozzle.
14. Rotate the nozzle flow control handle to the FULL OPEN position. The handle should rotate 180 degrees to ensure the poppet valve is fully open and locked. (vehicle operator)

CAUTION

The flow control handle of the single point pressure refueling nozzle shall be placed in either of two locked positions — fully open or fully closed. The handle is not to be used as a flag to indicate fuel flow. Excessive wear on the tank/truck adapter and the fuel nozzle poppet will result if the handle is allowed to float in the unlocked position.

15. Start filling operation slowly. (vehicle operator and refueling point operator)

CAUTION

Trucks that have been completely drained shall be minimally filled at a slow flow rate in order to cover the bottom inlet valve inside the tank prior to providing increased flow rates.

16. Monitor the meter throughout the loading evolution until the desired amount is dispensed into the truck/tank. (refueling point operator)



**WARNING**

Personnel should not be on top of the tank/truck during the loading operation. Tanks being filled should be monitored via the meter during the filling process. Secure pumping if the meter exceeds the amount required for the tank. Do not overfill.

17. When directed by the vehicle operator, stop the fuel flow. (refueling point operator)
18. Rotate the nozzle flow control handle into the OFF and fully locked position. (vehicle operator and verified by the refueling point operator)

WARNING

Failure to lock the flow control handle in the OFF position can contribute to a failure of the nozzle's safety interlock system and could result in a fuel spray or spill.

19. Disconnect nozzle from the tank/truck adapter. (vehicle operator)
20. Disconnect the bonding cable from the tank/truck. (vehicle operator)
21. Disconnect the earth ground from the tank/truck and stow away to its proper position. (vehicle operator and refueling point operator)
22. Stow the hose and return the nozzle to its proper position. (vehicle operator and refueling point operator)
23. Complete paperwork. (vehicle and refueling point operator)
24. Inspect the tank/truck for leaks. (vehicle operator)
25. Remove refueler from the loading area. (vehicle operator)

18.4.2 Cold Refueling Aircraft with Mobile Refuelers

Units shall dispatch their mobile refuelers (i.e., MK970) and record their movements and operations utilizing Form NAVMC 10031 (Daily Dispatch Record of Vehicles) and Form NAVMC 10627 (Vehicle and Equipment Operational Record).

18.4.2.1 Positioning of Refueler

Positioning of refuelers to service aircraft shall be performed in the same manner without variation so all personnel involved know exactly what to expect. Whenever possible, refuelers shall proceed down a line of parked aircraft with the driving path perpendicular to the aircraft fuselage access, at the maximum distance hose length will permit servicing; however, at no time shall a truck approach closer than 10 feet of an aircraft. This normal refueler approach path, which is illustrated in [Figure 12-6](#), is applicable to all fixed-wing tactical aircraft and helicopters. Normally, no turns are made except at the end of the parking line. Driving between aircraft parked in line must be avoided; however, the preferred approach is not always possible. [Figure 12-7](#) shows acceptable alternate methods when aircraft are not parked in line or hose lengths are insufficient for service. [Figure 12-8](#) shows the safe approach paths to prop, prop/jet and transport aircraft, while [Figure 12-9](#) illustrates the alternate approach paths for helicopters.

Refuelers shall never:

1. Be left pointing toward any part of an aircraft.
2. Be driven in the area described by straight line projections connecting points 10 feet from an aircraft's extremities. (See [Figures 12-7](#), [12-8](#), and [12-9](#).)
3. Be backed in proximity to aircraft.





The refueler shall be parked in a position on the same side of the aircraft as the aircraft's adapter so that the vehicle operator has a direct line of sight to the refueling nozzle operator while actuating the deadman control. (MK970). The refueling hose shall not pass underneath or around the aircraft to reach the refueling receptacle.

WARNING

Failure of the vehicle operator to visually observe the nozzle operator throughout the refueling operation can lead to a fuel spill or fire.

18.4.2.2 Refueler Preparation**WARNING**

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

Prepare refueler for operations as follows:

1. Recirculate (flush) the lines/hoses and take fuel sample for quality-control checks as appropriate. (vehicle operator)

WARNING

Fuel shall be recirculated/flushed through the refueling hose and nozzle, and tested for contamination prior to issuing fuel each day. Fueling shall not begin until acceptable results have been obtained. (See [Chapter 15](#).) Failure to provide clean, dry fuel can adversely affect safety-of-flight.

Note

Operators may recirculate the refueling system and take samples with the SPR nozzle in place, then replace the SPR with overwing nozzle immediately before commencing refueling operations if open-port refueling is required.

2. Drive refueler into position for refueling following approach paths discussed above. Refuelers shall be positioned so it can be driven away quickly in an emergency. No wheel chocks shall be used. (vehicle operator)
3. Set brakes. (vehicle operator)
4. Place gear shift in neutral. (vehicle operator)
5. Turn off headlights and unnecessary switches. (vehicle operator)
6. Open driver's side door. It shall remain partially open during the entire refueling operation. (vehicle operator)
7. Attach a grounding cable to the aircraft from an established earth ground. (nozzle operator)

18.4.2.3 Pressure Refueling**18.4.2.3.1 Personnel Requirements**

Refueling aircraft with mobile refuelers is a two-person function requiring a nozzle operator and a vehicle operator (see [Chapter 14](#)). The nozzle operator shall assist the driver/operator in removing and replacing the hose on the





refueler in order to minimize wear and damage to the hose and refueling nozzle. The Airfield Operations Officer will coordinate with tenant squadrons to provide nozzle operators for transient aircraft.

In an emergency the vehicle operator's first duties will be to release the deadman control and then man the fire extinguisher while the nozzle operator disconnects the nozzle from the aircraft. The nozzle operator shall then take over responsibility for the fire extinguisher while the driver/operator reels in the hose and removes the truck from the area.

18.4.2.3.2 Procedures

When refueler is in position and prepared as above, conduct refueling operations as follows:

1. Check for hot brake conditions. (nozzle operator)

Note

Hot brake check is applicable to fixed-wing aircraft, or as required.

2. Pilot (or plane captain) shall secure all unnecessary electronic and electrical equipment not required for refueling.

Once a fueling evolution has commenced, the aircraft's electrical power status and connections shall not be changed until evolution has been completed or refueling has been stopped for an emergency (e.g., no aircraft engines or APU shall be started or stopped and external power shall not be connected, disconnected, or switched on/off).

WARNING

Changing the aircraft's electrical power status can create significant ignition sources.

Note

Switching off the F-35 28V battery does not provide a hazardous ignition source and is an acceptable procedure during refueling.

3. Verify firefighting equipment is in the immediate vicinity of the refueling operation. (vehicle operator)
4. Attach a grounding cable from the aircraft to an established earth ground. (nozzle operator)
5. Zero the fueling system's meter or note the existing reading. (vehicle operator)
6. Pull out the refueling hose and place in proper position for refueling. (nozzle and vehicle operator)
7. Attach bonding cable between the refueler and the aircraft. (nozzle operator)
8. Remove refueling adapter cap from the aircraft and the dust cover from the nozzle. Inspect the face of the nozzle to ensure it is clean and verify the flow control handle is in the fully closed and locked position. (nozzle operator)
9. (Plane captain/aircrew) Visually inspect the aircraft's adapter (receptacle) for any damage or significant wear. If any doubt about the integrity of the adapter exists, do not refuel. (nozzle operator)

WARNING

A worn or broken adapter can defeat the safety interlocks of the refueling nozzle permitting the poppet valve to be in the open position when removed from the SPR adapter and fuel to spray or spill.





10. Lift nozzle by lifting handles, align the lugs with the slots on the aircraft adapter and hook up to the aircraft by pressing it firmly onto the adapter and rotating clockwise to a positive stop. (nozzle operator)

WARNING

Nozzle must seat firmly on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system that can lead to a fuel spray or spill.

Note

Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. A defective or worn aircraft SPR can also be detected in this manner.

11. Upon receiving signals from nozzle operator/plane captain that hook-up has been completed and fueling operation is ready to begin, refueling point operator charges the system, allowing fuel to flow to the nozzle.

WARNING

Deadman controls are not to be blocked open or otherwise inhibited, as this will defeat the purpose of the device and can lead to a catastrophic accident.

12. When hose is fully charged, rotate the nozzle flow control handle to the FULL OPEN position. The handle shall rotate 180 degrees to ensure the poppet valve is fully open and locked. (vehicle operator)

WARNING

The flow control handle of the single point pressure refueling nozzle shall be placed in either of two locked positions — fully open or fully closed. The handle is not to be used as a flag to indicate fuel flow. Excessive wear on the aircraft's adapter and the fuel nozzle poppet will result if the handle is allowed to float in the unlocked position.

13. Once fuel flow has been established, exercise the aircraft's precheck system. (nozzle operator)



**Note**

- The precheck system simulates the completion of refueling by closing all of the tank shut-off valves within the aircraft. All fuel flow into the aircraft should stop within a few seconds to 1 minute of actuating the precheck system. On aircraft equipped with a fuel indicator, the primary means of detecting successful precheck is by observing the flow indicator on the aircraft to make sure that it stops. If the aircraft is not configured with a flow indicator, or if the aircraft flow indicator is inoperative, the only acceptable means of determining that precheck has been successful is to watch the fuel delivery system's flow counter (flow meter) to ensure it stops. A stiffening (or jerking) of the refueling hose or indication of a fueling pressure spike is not a suitable indication that precheck has successfully occurred (hose stiffening/jerking and pressure spikes can occur whenever one or more aircraft fuel tank refueling valves close).
 - Aircraft may be cold refueled if it fails precheck, but special procedures are required. This should be done only as an operational necessity. Refer to appropriate aircraft NATOPS Manual.
14. Fuel aircraft as directed by nozzle operator. Nozzle operator shall monitor aircraft vents, tank pressure gauge(s) and/or warning lights as necessary.
 15. When directed by the nozzle operator/plane captain, stop the flow of fuel using the deadman control. (vehicle operator)
 16. Rotate the nozzle flow control handle into the OFF and fully locked position. (nozzle operator and verified by the vehicle operator)

WARNING

Failure to lock the flow control handle in the OFF position can contribute to a failure of the nozzle's safety interlock system and could result in a fuel spray or spill.

17. Disconnect nozzle from the aircraft adapter. (nozzle operator)
18. Disconnect the bonding cable from the aircraft and stow away. (nozzle operator)
19. Disconnect the earth ground from the aircraft and stow away to its proper position. (nozzle operator and vehicle operator)
20. Stow the hose and return the nozzle to its proper position. (nozzle operator and vehicle operator)
21. Complete paperwork. (nozzle and vehicle operator)

18.4.2.4 Overwing/Open-Port Refueling**18.4.2.4.1 Personnel Requirements**

Overwing refueling aircraft with mobile refuelers is a three-person function requiring a nozzle operator, a vehicle operator, and a fire-extinguisher operator (see [Chapter 14](#)). The nozzle operator shall assist the vehicle operator in removing and replacing the hose on the refueler. The Airfield Operations Officer will coordinate with tenant squadrons to provide fire extinguisher and nozzle operators for transient aircraft.





18.4.2.4.2 Procedures

WARNING

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

Once the refueler is in position and prepared as stated in [paragraphs 18.4.2.1](#) and [18.4.2.2](#), conduct fueling operations as follows:

WARNING

Overwing refueling with the aircraft's engines operating is not authorized.

1. Check for hot brake conditions. (nozzle operator)

Note

Hot brake check is applicable to fixed-wing aircraft, or as required.

2. Pilot (or plane captain) shall secure all unnecessary electronic and electrical equipment not required for refueling.
3. Verify firefighting equipment is in the immediate vicinity of the refueling operation and manned. (vehicle operator)
4. Attach a grounding cable to the aircraft from an established earth ground. (nozzle operator)
5. Attach bonding cable between the refueling vehicle and the aircraft. (vehicle operator)
6. Zero the refueling system's meter or note the existing reading. (vehicle operator)
7. Pull out the refueling hose and place in proper position for refueling. (nozzle and vehicle operator)
8. Bond the overwing nozzle to the aircraft. (nozzle operator)

WARNING

Always bond the nozzle to the aircraft before the fill cap is removed. This connection shall remain in place until the entire fueling operation is complete. Failure to bond nozzle and/or maintain contact can result in a dangerous static spark inside the fuel tank.

9. Remove refueling cap from the aircraft and the dust cover from the nozzle. (nozzle operator)
10. Insert overwing nozzle into the aircraft's refueling port and maintain metal-to-metal contact between the overwing nozzle and the aircraft's refueling port throughout the entire fueling operation. (nozzle operator)
11. Upon receiving signals from nozzle operator/plane captain that hook-up has been completed and fueling operation is ready to begin, refueling point operator charges the system allowing fuel to flow to the nozzle.



**WARNING**

Deadman controls shall not be blocked open or otherwise inhibited (i.e., MK970). This defeats the purpose of the device and can lead to a catastrophic accident.

12. Nozzle operator shall squeeze the handle on the overwing nozzle to initiate fuel flow and fuel aircraft as directed by nozzle operator/plane captain. Nozzle operator/plane captain shall monitor aircraft vents, tank pressure gauge(s) and/or warning lights as necessary.
13. When directed by the nozzle operator/plane captain, stop the flow of fuel (use deadman control if so equipped). (vehicle operator)
14. Remove the nozzle from the aircraft. (nozzle operator)
15. Disconnect bonding cable from the aircraft and stow it away. (nozzle operator)
16. Disconnect earth ground from the aircraft and stow away to its proper position. (nozzle and fire-extinguisher operator)
17. Stow the hose and return the nozzle to its proper position. (nozzle operator and vehicle operator)
18. Complete paperwork. (nozzle and vehicle operator)

18.4.3 Refueler Parking

All refueling vehicles shall be constantly attended whenever the engine is operating. Operator is considered in attendance when performing tasks directly associated with fueling an aircraft (e.g., assisting aircraft refueling operator, transporting hose, etc.). If for any reason the operator leaves the truck unattended, he/she shall first:

1. Drive truck clear of aircraft.
2. Place air brake in the ON and LOCKED position, if applicable.
3. Set parking brakes.
4. Direct front wheels to an open unobstructed area.
5. Stop engine.
6. Chock the drive wheels.

18.5 FUELING WITH ENGINES OPERATING (HOT REFUELING)

Hot refueling shall be performed only when operational requirements dictate the need for rapid turnaround of aircraft since this operation is significantly more dangerous and costly — both in terms of fuel and manpower expenditures. Hot refueling shall be performed only with the SPR or CCR nozzles. Open-port hot refueling is not authorized.

18.5.1 Personnel Requirements

A minimum of four personnel are required for hot refueling aircraft: a nozzle operator, a refueling point operator, a pump operator, and a line NCO. All personnel performing hot refueling operations shall be fully trained and qualified in accordance with [Chapter 14](#) of this manual.

18.5.2 Equipment Requirements

The following equipment is the absolute minimum required to conduct hot refueling operations.

1. One fuel service system, such as a TAFDS, HERS, or a MK970 (configured with external hoses, etc.). The system shall possess all of the required features listed in [Chapter 17](#) (e.g., filter/separator). Equipment shall





be grounded (earthed) through a connection of 10,000 ohms or less resistance. The servicing system fuel supply tank(s) shall be located at least 150 feet from the refueling point.

2. Bonding cables attached to refueling nozzles that provides an overall resistance of 10,000 ohms or less.

WARNING

Large static producing equipment and the aircraft being refueled must be grounded to earth.

3. Aircraft wheel chocks. (provided by the supported squadron)
4. Sound-attenuating ear protectors, goggles, cranials, long sleeved shirts, and pants for each member. Personnel shall avoid wearing shoes that have nails or other metal devices on the soles, which can cause sparking.
5. A fire extinguisher at each refueling point (see NATOPS Aircraft Firefighting and Rescue Manual, NAVAIR 00-80R-14 [ARFF]). Availability of assets will dictate extinguisher sizes actually emplaced, but every effort shall be made to provide for the required extinguishers from the host ARFF Branch. At an absolute minimum, extinguishers provided by authorized equipment allowances shall be emplaced.

WARNING

All ground personnel involved in hot refueling operations shall be qualified in the operation of the extinguishing equipment in use.

18.5.3 Hot Refueling Procedures

18.5.3.1 Initial Hot Refueling Procedures Prior to Entering the Refueling Area

The following steps shall be accomplished prior to entering the hot refueling area.

1. Recirculate (flush) the system or mobile refueler's hoses and take a fuel sample for quality control checks as appropriate. (refueling point operator)

Note

- Fuel shall be recirculated/flushed through the refueling hose and nozzle, and tested for contamination prior to issuing fuel each day. Fueling shall not begin until acceptable results have been obtained (see [Chapter 15](#)). Failure to provide clean, dry fuel can adversely affect safety-of-flight.
 - No nozzle sample shall be taken after the aircraft has taxied into the designated hot refueling area. Sampling increases the possibility of a fuel spill in the presence of an ignition source.
2. The area shall be policed for FOD.
 3. Verify firefighting equipment is in the immediate vicinity of the loading operation. (line NCO)
 4. Check for hot brake conditions. (designated personnel)

WARNING

Hot refueling shall not be performed if a hot brake condition exists.



**Note**

- Hot brake check is applicable to fixed-wing aircraft, or as required.
 - Hot brake checks are not required for AV-8B aircraft conducting Field Carrier Landing Practices.
5. Certified and qualified squadron personnel shall verify all ordnance is safed. Safed is defined as the replacement of any mechanical arming level, safety pin, electrical interrupt plug/pin, securing of armament switches, and/or any appropriate action that renders the particular ordnance carried as safe.

Note

Hot refueling of explosive-loaded combat aircraft is authorized at Forward Operating Bases (FOBs) and Forward Arming and Refueling Points (FARPs) in support of contingencies, operations, exercises, and training.

6. Hot refueling of explosive-loaded combat aircraft is not authorized at Marine Corps Air Stations/Air Facilities using tactical fuel systems. Dummy ordnance, practice ordnance containing only flash or impact signal cartridges, training missiles without live warheads and motors, internally carried pyrotechnics and SUS charges, aircraft peculiar cartridge actuated devices, de-armed internally mounted guns loaded with target practice ammunition, and USMC aircraft loaded with sympathetically initiated decoy flares and chaff are excluded from this requirement.

WARNING

- USMC UC-35 aircraft are not authorized for hot refueling with decoy flares due to insufficient safety features except when specifically authorized by NAVAIR 00-80T-109 for FARP and FOB operations.
- Hot refueling of aircraft with hung ordnance of any type is prohibited.
- Aircraft de-arming and re-arming shall be carried out in designated areas prior to entry and after departure from refueling pits
- MJU-8/B, MJU-8A/B, MK-46, M206, M211, M212, MJU-46/B and MJU-50/B decoy flares are not authorized for hot refueling operations.

18.5.3.2 Hot Refueling Procedures in the Refueling Area**WARNING**

Grounding/bonding to external doors, latches, hinges or other non-approved locations will compromise continuity and increase the risk of static discharge.

Once the aircraft has been determined ready for entry into the hot refueling area, the following steps shall be performed:

1. The aircraft shall be taxied into the hot refueling area as determined by local SOPs. The aircraft shall enter the area with the refueling receptacle on the side of the aircraft nearest the refueling hose/nozzle. Primary aircraft directors are aircraft crewchiefs, plane captains or trained and qualified squadron personnel or visiting aircraft line personnel. Utilization of refueling personnel as aircraft directors will be restricted to tactical environments.

The following prohibitions shall be observed:

- a. Servicing the AV-8B's water injection system/tank is not authorized in the refueling area.





- b. The refueling hose shall not pass underneath or around the aircraft to reach the refueling receptacle. This may result in the severing of the hose in the event of malfunction or failure of the aircraft's landing gear.
 - c. Crew changes and hot seating shall not be conducted in the fuel pits.
 - d. Assume that both engines on dual-engine aircraft are operating.
 - e. Aircraft canopy and side doors (if installed) shall remain closed during the entire hot refueling evolution. Aircraft refueling operations shall be secured if canopy is opened.
 - f. Exceptions:
 - (1) Rear cargo doors and/or doors on opposite side of aircraft from the refueling adapter may be open, provided the refueling hose is positioned so that it is unlikely fuel sprays from nozzle/adapter malfunction or hose rupture will enter aircraft passenger/cargo/cockpit compartment(s).
 - (2) The AV-8B aircraft may be hot refueled with the canopy open at the pilot's discretion when high temperatures and humidity dictate since the aircraft's environmental control system does not operate with weight on wheels.
 - (3) The MH-60S helicopter may be hot refueled with the 20mm Gun System installed without the environmental barrier provided the left cabin door is held against the feed chute and the refueling hose is positioned so that it is unlikely fuel sprays from nozzle/adapter malfunction or hose rupture will enter aircraft cabin and/or cockpit compartment(s).
2. Pilot (or plane captain) shall secure all unnecessary electronic and electrical equipment not required for refueling.

Once a fueling evolution has commenced, the aircraft's electrical power status and connections shall not be changed until evolution has been completed or refueling has been stopped for an emergency (e.g., no aircraft engines or APU shall be started or stopped and external power shall not be connected, disconnected, or switched on/off).

WARNING

Changing the aircraft's electrical power status can create significant ignition sources.

Note

Switching off the F-35 28V battery does not provide a hazardous ignition source and is an acceptable procedure during refueling.

- 3. Verify manned firefighting equipment is in the immediate vicinity of the refueling operation and manned. (refueling point operator)
- 4. Attach a grounding cable to the aircraft from an established earth ground. (nozzle operator)
- 5. Zero the fueling system's meter or note the existing reading. (refueling point operator)
- 6. Pull out the refueling hose and place in proper position for refueling. (nozzle operator and refueling point operator)
- 7. Remove refueling adapter cap from the aircraft and the dust cover from the nozzle. Inspect the face of the nozzle to ensure it is clean and verify the flow control handle is in the fully closed and locked position. (nozzle operator)
- 8. (Plane captain/aircrew) Visually inspect the aircraft's adapter (receptacle) for any damage or significant wear. If any doubt about the integrity of the adapter exists, do not refuel.



**WARNING**

A worn or broken adapter can defeat the safety interlocks of the refueling nozzle permitting the poppet valve to be in the open position when removed from the SPR adapter and fuel to spray or spill.

9. Lift nozzle by lifting handles, align the lugs with the slots on the aircraft adapter, and hook up to the aircraft by pressing it firmly onto the adapter and rotating clockwise to a positive stop. (nozzle operator)

WARNING

Nozzle must seat firmly on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system that can lead to a fuel spray or spill.

Note

Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. A defective or worn aircraft SPR can also be detected in this manner.

10. Upon receiving signals from nozzle operator/plane captain that hook-up has been completed and fueling operation is ready to begin, refueling point operator signals the pump operator to charge the system allowing fuel to flow to the nozzle.

WARNING

- Deadman controls are not to be blocked open or otherwise inhibited, as this will defeat the purpose of the device and can lead to a catastrophic accident.
 - Discontinue refueling immediately if any leaks are discovered throughout the operation.
11. When hose is fully charged, rotate the nozzle flow control handle to the FULL OPEN position. The handle shall rotate 180 degrees to ensure the poppet valve is fully open and locked. (nozzle operator)

WARNING

The flow control handle of the single point pressure refueling nozzle shall be placed in either of two locked positions — fully open or fully closed. The handle is not to be used as a flag to indicate fuel flow. Excessive wear on the aircraft's adapter and the fuel nozzle poppet will result if the handle is allowed to float in the unlocked position.

12. Once fuel flow has been established, exercise the aircraft's precheck system. (nozzle operator)



**Note**

- The precheck system simulates the completion of refueling by closing all of the tank shut-off valves within the aircraft. All fuel flow into the aircraft should stop within a few seconds to 1 minute of actuating the precheck system. On aircraft equipped with a fuel indicator, the primary means of detecting successful precheck is by observing the flow indicator on the aircraft to make sure that it stops. If the aircraft is not configured with a flow indicator, or if the aircraft flow indicator is inoperative, the only acceptable means of determining that precheck has been successful is to watch the fuel delivery system's flow counter (flow meter) to ensure it stops. A stiffening (or jerking) of the refueling hose or indication of a fueling pressure spike is not a suitable indication that precheck has successfully occurred (hose stiffening/jerking and pressure spikes can occur whenever one or more aircraft fuel tank refueling valves close).
 - Aircraft may be hot refueled if it fails precheck, but special procedures are required. Refer to appropriate aircraft NATOPS Manual. This should be done only as an operational necessity.
13. Fuel aircraft as directed by nozzle operator/plane captain. Nozzle operator/plane captain shall monitor aircraft vents, tank pressure gauge(s) and/or warning lights as necessary.
 14. When directed by the nozzle operator/refueling point operator, stop the flow of fuel by using the deadman control if so equipped. (refueling pump operator)
 15. Rotate the nozzle flow control handle into the OFF and fully locked position. (nozzle operator and verified by the refueling point operator)

WARNING

Failure to lock the flow control handle in the OFF position can contribute to a failure of the nozzle's safety interlock system and could result in a fuel spray or spill.

16. Disconnect nozzle from the aircraft adapter. (nozzle operator)
17. Disconnect the bonding cable from the aircraft. (nozzle operator)
18. Disconnect the earth ground from the aircraft and stow away to its proper position. (nozzle operator and refueling point operator)
19. Stow the hose and return the nozzle to its proper position. (nozzle and refueling point operator)
20. Complete paperwork. (refueling point operators)
21. Aircraft shall depart the hot refueling area under the guidance of a qualified aircraft director.

18.6 MULTIPLE SOURCE REFUELING

Normally, only one refueling truck at a time is used to service aircraft; however, there are situations when multi-truck servicing is considered desirable, especially when very large aircraft must be refueled. The advantage to multiple source refueling is reduced aircraft turnaround time. The aircraft's NATOPS Manual, USAF Technical Order (TO), or equivalent aircraft servicing manual shall be consulted for specific guidelines and instructions before such operations are performed. In addition, the instructions and guidelines on multi-source refueling contained in USAF TO 00-25-172 shall be followed since the vast majority of aircraft involved belong to the USAF. This TO is available from WR-ALC/MMEDT, Robins AFB, Georgia 31098. Specific aircraft TOs may be obtained from SA-ALC/MMEDT, Kelly AFB, San Antonio, TX 78241.





18.7 TRANSFERRING FUEL FROM ONE AIRCRAFT TO ANOTHER

Some special purpose operations have been developed in which fuel is removed from an aircraft and directly loaded into another aircraft (or ground vehicle). As discussed in [paragraph 18.10](#) of this chapter, aircraft defueling is a very dangerous and demanding operation. In addition, the immediate reuse of fuel removed from an aircraft without proper filtration and handling can adversely affect safety-of-flight. Only NAVAIR approved transfer operations are authorized. Appropriate safety precautions shall be observed at all times during these operations. Specific examples of approved operations listed below:

1. Refueling aircraft, fuel storage bladders, or ground vehicles from KC-130 aircraft.
2. Refueling aircraft, fuel storage bladders, or ground vehicles from CH-53 aircraft.
3. Transfer of fuel between aircraft using Plane-to-Plane Transfer Cart. For a detailed description of this equipment and procedures for its use refer to [Chapter 6, paragraph 6.2.10.2](#) of this NATOPS Manual.

18.8 REFUELING AIRCRAFT WITH AUXILIARY POWER UNIT (APU) IN OPERATION

The aircraft APU may be used to supply electrical power for pressure refueling on military aircraft so equipped and commercial aircraft (when the procedure is approved by the FAA for a carrier's aircraft in commercial operation). This operation is not considered "hot refueling"; however, the following precautions shall be observed in addition to the normal refueling procedures.

1. One person shall remain outside the aircraft within 10 feet of the APU exhaust with a fire extinguisher of the size specified by the fire chief.
2. Refueling point operator will verify the aircraft is grounded and bonded.
3. One person shall be located at the GTC controls in the cockpit.
4. Intercom shall be established between the cockpit and personnel performing refueling to ensure immediate shutdown in the event of an emergency.
5. Personnel in the vicinity of the aircraft shall wear sound-attenuating ear protectors.

18.9 CONCURRENT ON-LOADING/OFF-LOADING AND REFUELING OF AIRCRAFT

Note

Simultaneous fueling of logistical/mobility/commercial aircraft while loading passengers/ cargo, performing minor maintenance, aircrew performing inspections, or operating aircraft systems is considered normal fueling operations, and does not require concurrent refueling procedures. Concurrent refueling procedures are required for refueling with JP-4, or simultaneous refueling while loading/downloading munitions/explosives.

Where concurrent refueling/loading/off-loading operations are required, COs shall establish local regulations and procedures to ensure safety. In addition, the CO shall clearly designate one qualified person in charge of each operation. For reference purposes in this chapter, the person in charge will be called the Quick Service Supervisor (QSS), but in actual practice both his/her title and qualifications will be detailed in local regulations.

All tasks concerning the operation will be performed under the observation and control of a QSS. The QSS will be present at the site and shall be responsible and have jurisdiction, authority, and coordination over all service operations including refueling trucks/equipment, fueling procedures, power units, loading/unloading equipment, passenger management, and communication systems to ensure safety of all aspects of refueling operations. No concurrent refueling shall commence until the QSS has been identified and established in control. The refueling will commence only upon a signal from the QSS.

The following procedures and precautions shall be included in the local regulations and procedures:

1. All vehicles to be operated within a 50-foot radius of the refueling point shall be equipped with spark arrestors and designated in advance.





2. Appropriate size and type fire extinguishers as recommended by NAVAIR 00-80R-14 shall be located in the immediate vicinity.
3. A stand-by alert crash truck (NAVAIR 00-80R-14 para 5.6.2) shall be required at the aircraft when passengers or patients remain onboard during concurrent refueling operations.
4. When passengers or patients are permitted to remain onboard, necessary ramps (unobstructed) shall be located in proper position to permit evacuation.
5. Major aircraft maintenance repair work and liquid oxygen servicing shall not be permitted during refueling.
6. A communication system (radio vehicle or other effective means) shall be maintained to permit the CO's designated person-in-charge to contact the stand-by alert crash truck in the event of an emergency.
7. Clear paths shall be maintained around aircraft being serviced at all times.

18.10 DEFUELING AIRCRAFT

Defuelings normally have lower priority than refuelings. A defuel request for an aircraft that is leaking fuel shall be considered an emergency and handled promptly.



- The pump's effluent (discharge) shall be regulated to balance its influent (fuel from aircraft) in order to prevent pump cavitation and/or the loss of suction.
- Damage to aircraft fuel tank can occur if the vacuum pressure exceeds -7 psig.

Note

The desire to satisfy customer requests for the acceleration of the process shall not be granted.

The following rules apply to every defueling operation:

1. Aircraft defueling shall be requested by an authorized representative of the squadron's CO using an Aircraft Defueling Certificate similar to [Figure 12-12](#).
2. During defueling operations, all maintenance not directly required to facilitate the defueling operation is prohibited.
3. Do not start or stop any engine, regardless of its configuration, within 50 feet of a defueling operation. The starting or stopping of an engine within 50 feet of a fueling or defueling operation is sufficient cause for the operator to immediately shut down the fuel pump. Grounding and tiedown pad-eyes shall be available. In addition, at least one fire extinguisher having an ANSI rating of not less than 20-B shall be available in the immediate vicinity of the operation.
4. Suspect aviation turbine fuel shall be removed from the aircraft using a defueler only (not a refueler/defueler) and deposited in a designated holding tank. Ultimate disposition will depend on the results of subsequent laboratory tests. Every effort shall be made to reclaim off-specification fuel as JP-5, F-76, or Fuel Oil Reclaimed (FOR).
5. All fuel removed from turbine engined aircraft shall be assumed to be a mixture. Defueled turbine fuel shall therefore not be returned to JP-5 storage tanks without first confirming the flash point of the material to be 140 °F or higher.
6. Fuel containing leak detection dye can be reissued to aircraft of the same squadron as long as the squadron's requesting official signs a statement that the fuel is nonsuspect and is safe for use. Note that although refuelers/defuelers may be used to defuel dyed fuel, logistics problems may arise since several loads of fuel





may be needed to flush the dye out of the refueler/defueler. The fuel may appear off-color when sampled prior to issue to another squadron's aircraft.

7. The FO shall personally decide the disposition of all defueled product. Advice is readily available from the NAVSUP Energy Office.
8. The defueling unit is required to maintain a flooded suction above the anti-vortex splash plate in its tank in order to minimize turbulence and possible ingestion of air. Historically a minimum of 1,000 gallons has been required in the defueling unit to resolve turbulence and air ingestion problems. Due to the wide variety of configurations of pump piping systems and tank sizes, 1,000 gallons of product may or may not be sufficient. It is up to the local commands to determine the minimum amount by using manufacturers' technical manuals and historical data.
9. Valve(s) that control the flow of fuel from the tank to the upstream side of the pump shall remain closed during defueling operations. This is to prevent the recirculation of product in the tank. Valve(s) may be opened to prime the pump only when the pump is not operating.
10. If during the defuel operation the pump starts to lose prime or cavitates, the operation will be discontinued until the problem is resolved and the fuel supervisor has authorized a restart.



At no time will a restart be authorized without waiting a minimum interval of 1 minute to allow relaxation of any static charge.

11. Defueler tank tops shall remain closed during defueling operations.
12. Every aircraft defueling operation requires a minimum of three people — the defueler truck/vehicle operator, a nozzle operator, and a fire watchperson.
13. A special log of each defueling operation shall be maintained. The following minimum information shall be contained in the log:
 - a. Complete list of all squadron personnel authorized to sign defuel request forms. This list will be updated at least quarterly.
 - b. All abnormal happenings.
 - c. Aircraft BuNo number.
 - d. Defueler number.
 - e. Grade of product.
 - f. Amount of product actually defueled vice what was scheduled to be removed.
 - g. Scheduled amount to have been defueled.
 - h. Disposition of product.
 - i. Times of the day when the defuel operation was started and completed.
 - j. Names of defueler operator and squadron personnel present during the defuel operation.

18.10.1 Personnel Requirements

Each aircraft defueling operation requires a minimum of three people trained and certified in accordance with [Chapter 14](#): the defuel vehicle operator, a nozzle operator, and a fire watch. The fire watch will be provided by the supported squadron.





18.10.2 Defueling Procedures

Aircraft defueling tasks are to be performed in the following sequence:

1. Prior to initiating the defuel operation, take samples of the fuel to be defueled from the aircraft's drains and visually inspect them for contaminants. (qualified squadron personnel under the observation of the vehicle operator)
2. Determine the status of the fuel (i.e., suspect or nonsuspect (vehicle operator)). The person requesting the defueling operation shall confirm that the fuel is or is not suspect. Fuel is considered suspect if the aircraft has malfunctioned and the fuel is believed to have contributed to the problem or the fuel is thought to be of the wrong type (e.g., AVGAS or automotive gasoline instead of aviation turbine fuel).
3. Determine amount of fuel to be removed from the aircraft (vehicle operator). Again the squadron personnel requesting the defueling operation shall provide this estimate as part of the official request.

Note

If the aircraft is being defueled due to a faulty (or suspect) fuel quantity gauging system, it will be difficult to estimate amount of fuel in the aircraft.

4. Select defueling equipment to be used (e.g., defueler for suspect product or refueler/defueler for nonsuspect fuel) (FO and supported squadron's spokesperson). Always check the remaining capacity of the defueler or refueler/defueler to make sure there is adequate room to hold the material being defueled. In addition, remember that sufficient fuel shall be in the defueling tank to maintain a flooded suction above the anti-vortex splash plate.
5. Position the defueler. (vehicle operator)
6. Verify aircraft is spotted properly. (all personnel)
7. Ground defueler.
8. Ground aircraft.
9. Check for possible sources for ignition. (all personnel)
10. Verify the defueling request chit corresponds to the instructions from the dispatcher. (vehicle operator)
11. Connect bonding wire from defueler to aircraft. (vehicle operator)
12. Unload, position, and connect the defuel hose to the aircraft and the defueler stub on the defueler. The defuel hose shall not pass underneath or around the aircraft to reach the refueling receptacle. (nozzle operator)
13. Commence defueling upon signal from the nozzle operator. (vehicle operator)
14. Adjust valve downstream of pump to optimize defuel rate. (vehicle operator)



Discontinue defueling of an aircraft if pump cavitation is a persistent problem.

Note

Maximum defuel rate is 100 gpm (vehicle operator). When nearing completion of the defuel process, very close attention shall be paid to the defuel rate in order to prevent pump cavitation and/or loss of prime.

15. Upon completion of a defuel operation, secure all equipment and check the area for fod. (all personnel)





18.10.3 Disposition of Nonsuspect Fuel Removed from Aircraft

All USN and USMC aircraft are authorized to use JP-4, JP-8, F-24, commercial JET A and JET A-1, as well as JP-5 fuel. Fuel removed from a USN or USMC aircraft will contain mixtures of these fuels and the specific grade of fuel will be impossible to determine without extensive specification testing. USA and USAF aircraft may also contain such mixtures. Therefore, fuel in any properly operating DOD aircraft with turbine engines, which is not suspect of being contaminated, can be defueled into a designated refueling vehicle and then used to refuel any aircraft with the user's knowledge and permission. First preference shall be given to using the fuel to load an aircraft in the same squadron as that from which the fuel originated. Second choice shall be to issue the fuel to aircraft having engine fuel controls that automatically compensate for fuel density changes. Aircraft with T56 engines, such as the P-3 and E-2, should be preferentially used since these engines are the most tolerant to such fuel changes. In addition the following rules apply to reissuing defueled fuel:

1. Since fuel removed from any aircraft almost definitely has a flash point below 140°F, it shall not be used to refuel any aircraft scheduled for immediate sea duty.
2. Any designated defuel/refueler must pass fuel through filter/separators before reaching the aircraft.
3. The FSII content of defueled turbine fuel shall be checked using the nearest supporting laboratory prior to refueling USN S-3 and SH-60 aircraft, and all U.S. Army and U.S. Air Force and foreign aircraft.

Nonsuspect fuel that has been dyed for the detection of aircraft fuel system leaks can also be used in aircraft provided the above procedures are followed.

Nonsuspect fuel removed from piston-engined aircraft can also be reissued provided:

1. The fuel is a known grade (80/87 or 100/130).
2. The fuel is properly filtered before reissue.

18.10.4 Disposition of Suspect Fuel Removed from Any Aircraft

Fuel removed from any aircraft that has recently experienced engine or airframe fuel system problems possibly related to fuel quality will be segregated by collecting in a designated defueler, a clean storage tank, or any container as "salvage fuel." It will then be sampled and tested to determine if it is in conformance with the deterioration use limits outlined in [Appendix B](#). If the fuel tests within the established limits, it shall be returned to station storage and reissued as the grade and type determined providing adequate filtration and water separation can be accomplished prior to dispensing the fuel.

18.10.5 Handling NATO F-37 (JP-8+100)/F-27 (F-24+100) Fuel

NATO F-37 (JP-8+100)/F-27 (F-24+100) is NATO F-34 (JP-8)/F-24 which has been additized with a thermal stability improving additive. The thermal stability additive is a dispersant/detergent that:

1. Disarms filter-coalescer elements
2. Makes free water readings taken with the Aqua-Glo Free Water Detector and digital free water detector unreliable.

It is possible that transient USN/USMC aircraft may receive NATO F-37/F-27 inadvertently when conducting joint operations requiring refueling from air stations operated by the USAF, US Army and NATO member air forces that utilize NATO F-37/F-27.

Note

NATO F-37/F-27 is not authorized for use in USAF or other NATO member nations' aerial refueling aircraft.

If aircraft are suspected of having received NATO F-37/F-27, and need to be defueled, handle defueling as follows:

3. Defuel into refueler/defueler and immediately reissue fuel (as long as no other contamination is suspected). Priority of reissue shall be as follows:





- a. Directly to same or other aircraft
- b. To aviation ground support equipment
- c. To aviation test cells.
- d. Return to bulk storage (RTB), if the dilution ratio is equal to or greater than 1:10 (+100 fuel:bulk storage fuel).

Note

For RTB operations, fuel containing the +100 additive shall not exceed 10 percent of total fuel volume in the tank.

4. If other contamination is suspected, all fuel defueled from the aircraft shall be treated as hazardous waste and handled accordingly.
5. After reissuing NATO F-37/F-27 fuel from refueler/defueler, the following steps shall be taken:
 - a. Refill the refueler/defueler with NATO F-44 (JP-5), NATO F-34 (JP-8), or NATO F-24.
 - b. Note the differential pressure readings for the filter-coalescer elements.
 - c. Issue fuel to aircraft following normal operating procedures.
 - d. Change the filter-coalescer when the differential pressure across the filter separator elements reaches 15 psi or the fuel flow degrades significantly.

Notify TYCOMs and AIR-4.4.5 via naval message of any actual/suspected NATO F-37/F-27 defueling.

18.10.6 Disposition of Fuel that Does Not Meet the Allowable Deterioration Limits

Fuels that do not meet the allowable deterioration use limits of [Appendix B](#) will be handled as directed below.

18.10.6.1 Disposition of Aviation Turbine Fuels

Aviation turbine fuels that do not meet the requirements specified herein generally cannot be downgraded for any aircraft use. The only significant exception to this rule is JP-5 which has a reduced flashpoint due to mixing with other turbine fuel. As explained above, this fuel is perfectly acceptable for use in USN and USMC aircraft. It should not, however, be loaded aboard aircraft scheduled for immediate sea duty. Questions concerning the use or disposition of fuel not meeting the deterioration use limits should be referred to the NAVSUP Energy Office (Code 70), DSN 427-7377; commercial 703-767-7377. In no case will fuel not meeting the deterioration use limits of [Appendix B](#) be allowed to mix with existing uncontaminated aircraft fuel.

18.10.6.2 Disposition of Aviation Gasoline

Any questions concerning the use or disposition of fuel not meeting the use limits should be referred to the NAVSUP Energy Office (Code 70), DSN 427-7377; commercial 703-767-7377.

18.11 PRODUCT RECEIPT

18.11.1 Bulk Transfer Line Receipt of Product

Bulk transfer line receipt operations are relatively simple and therefore require minimum personnel. Bulk transfer operations rarely occur between the FMF's Wing and MLG units in a training environment; however in the event of such an operation, the following procedures apply:

1. Advise supporting unit of requirements (e.g., when required, amount, special instructions, etc.)
2. Effect liaison with the unit providing the product and ensure an adequate communications network is established in order to control the flow of product. Maintain communications throughout the bulk transfer operation.





3. Visit the supporting unit and conduct a joint inspection of their bulk transfer line.
4. Conduct a joint test of the product to be received per [paragraph 15.2.1.2](#) of this NATOPS Manual.
5. Maintain an operations observer with the supporting unit until completing of the bulk transfer operation. This is a precautionary measure that should be followed when a supporting unit's personnel proficiency cannot be personally guaranteed by the FO or his senior representative.
6. Identify a segregated container/tank into which the initial purge will be directed (sump). Once contaminants have settled out or been removed through filtration this initial purge fuel may be used. If the supporting unit provides an in-line filter separator at the receiving system, the initial purge should not be a concern. (This is the recommended method of receipt.)
7. Ensure all manifolding/valves within the system are properly positioned (open/closed) to direct the fuel into the predetermined tanks. Ensure personnel are on sight to monitor the receipt and open/close valves as necessary to redirect the flow of fuel to other tanks in the receiving system.
8. Provide line walkers as required. Coordinate with the supporting unit to ensure they have provided line walkers on their bulk transfer line also.
9. Provided the fuel is suitable for use, initiate delivery via the established communications link. Maintain communications throughout the transfer evolution.
10. Monitor flow of fuel until complete.
11. Inspect system components as required in applicable TMs (e.g., TM-3835).
12. Incorporate quality surveillance steps as required prior to dispensing fuel to aircraft.

18.11.2 Tank Truck/Tank Car Receipt of Product

Incoming tank trucks and tank cars of aircraft fuel can arrive separately or in groups. All shall be sealed at the source of supply. Unloading of tank trucks is a two-man operation. The following procedures apply to both tank truck and tank car receipt:

1. Ensure seals are intact (applies to fuels received from external sources).
2. Verify seal number is identical to that on the shipping document.
3. Verify the specification and grade number of the product on the shipping document.
4. Ensure the fuel level coincides with the quantity on the shipping document.
5. Take samples after drawing off water (if present).
6. Make visual test of samples.
7. Unload product into suitable storage tank.
8. Check vehicle's tank interior after delivery.
9. Upon completion of fuel receipt (multiple tank cars or truck loads), sample storage tank and perform quality control test.

18.11.3 Fabric Drums or 55-Gallon Metal Drums Receipt of Product

1. Verify the quantity, product specification and grade number on DD Form 250 or other applicable shipping document.
2. AVGAS samples will be checked for solids, water and API gravity prior to receipt. When no laboratory is available to perform these tests, solids be determined visually upstream of filter-separators and by the particle assessment method downstream of the filter separator.
3. Transfer drums to appropriate storage location(s) and clearly mark and segregate drums from different batch/lots.





4. If transferring fuel to a bulk storage tank, sample tank afterwards and perform quality control test.

18.11.4 Change of Product in Aircraft Defuelers

Change of product in mobile refuelers shall be performed in accordance with [Figure 12-13](#). Product that is used to flush tanks and piping shall be treated as contaminated fuel. Samples shall be visually inspected for sediment/particulates and water and its specific gravity shall check within 0.5 degrees of the corrected API of the appropriate product in storage.

18.11.5 Change of Product in Storage Tanks

Refer to the container's supporting publications and directives (e.g., 20,000-gallon collapsible tank, TM-3835).

18.12 FORWARD ARMING AND REFUELING POINT (FARP) PROCEDURES

The procedures in this section are for use in a Forward Arming and Refueling Point (FARP). Cold and hot refueling of helicopters carrying ordnance are authorized in a FARP.

18.12.1 Personnel Requirements

A minimum of six personnel (not including four ordnance personnel) are required for cold or hot refueling aircraft at a two-point FARP (if the FARP contains additional points, the number of personnel required will increase). Three personnel are required for mobile cold refueling an aircraft at a single point. All personnel performing refueling operations shall be fully trained and qualified in accordance with [Chapter 14](#) of this manual.

18.12.1.1 Two-Point FARP Personnel Requirements

Personnel required for FARP operations are nozzle operators, refueling point operators, pump operators, and line NCOs. All personnel performing refueling operations shall be fully trained and qualified in accordance with [Chapter 14](#) of this manual. (Example: A minimum of six personnel are required for a two-point FARP: two nozzle operators, two refueling point operators, one pump operator, and one line NCO.)

18.12.2 Equipment Requirements

The following equipment is the minimum required to conduct refueling operations at FARP sites:

1. One fuel service system, such as a SIXCON, HERS, FRC, or an MK970 (configured with external hoses, etc.). The system shall possess all the required features listed in [Chapter 17](#) (e.g., filter/seperator).

WARNING

- Large static producing equipment and the aircraft being refueled must be grounded to Earth through a connection of 10,000 ohms or less.
 - Stationary refueling equipment (HERS) shall be positioned a minimum of 150 feet from the aircraft refueling line.
 - Mobile refueling equipment (MK970, SIXCON, FRC) shall be positioned a minimum of 150 feet from the aircraft refueling line during hot refueling.
 - Stationary hot refueling points shall be positioned a minimum of 150 feet apart.
2. Bonding cable attached to refueling nozzles that provides an overall resistance of 10,000 ohms or less. This will satisfy both refueling and ordnance loading requirements.
 3. Night Vision Devices (NVD). The Line NCO, pump/vehicle operator, and at least one of the ordnance personnel, should have a night vision capability for night operations.





4. Appropriate eye, ear, and head protection; long-sleeved shirts; and long pants for each member are mandatory. Personnel shall avoid wearing shoes that have nails or other metal devices on the soles, which can cause sparking.
5. Fire extinguisher. A 30-pound potassium bicarbonate (or apparatus with the same or better capability) fire extinguisher is required at each aircraft refueling point. Additionally, the minimum aircraft rescue firefighting capability in accordance with NAVAIR 00-80R-14, Aircraft Firefighting and Rescue (ARFF) NATOPS Manual is required.

WARNING

All ground personnel involved in FARP refueling operations shall be qualified in the operation of the fire extinguishing equipment in use.

18.12.3 Communication Procedures

Communications between ground to ground and air to ground personnel is required. The FARP shall be equipped with VHF-FM and UHF radios to expedite control/emergency measures during refueling operations. Radio transmissions shall be kept to a minimum during dearming, refueling, and arming procedures. Aircraft and ground personnel should make initial contact with one another prior to aircraft entering the FARP.

CAUTION

Due to the complexity and inherent danger of FARP operations, especially those conducting hot refueling with explosive ordnance onboard, FARP OIC/air boss responsibilities shall be assigned to a person with the training and experience to adequately carry out these duties. FARP OIC/air boss shall have a working knowledge of the Marine Aviation Command and Control System (MACCS) sufficient to allow him to deconflict and control aircraft in and around the FARP site, establish priority of support within the FARP based on mission requirements, and provide transitioning pilots with situational updates as required.

Note

- Fueling personnel should be positioned so that a clear line of sight is always maintained with all essential personnel so that hand and arm signals may be effectively passed.
- At a minimum, the following personnel will have established both internal and external communications for proper control. All communications shall be compliant with HERO (Hazards of Electromagnetic Radiations) considerations.
 - Aircraft to FARP OIC or air boss.
 - FARP OIC to ordnance.
 - FARP OIC to fuels.
 - FARP OIC to ARFF.
 - Fuels to fuels.
 - Fuels to ordnance.





18.12.4 Fueling Helicopters with Engines Not Operating (Cold Refueling)

Cold refueling shall be performed when operational requirements permit. This operation is significantly less dangerous and costly, in terms of fuel and manpower expenditures, compared to hot refueling. Cold refueling may be performed with the SPR, CCR, or gravity (open port) nozzles.

18.12.4.1 FARP Cold Refueling Sequence of Events

1. Aircraft enter FARP and land at designated spots.
2. Aircraft are dearmed and shut down.
3. Aircraft are refueled.
4. Aircraft are uploaded as required.



No matter what sequence items 3 and 4 are performed in, the operations shall meet established safety distance requirements.

Note

Items 3 and 4 can occur in the reverse sequence.

5. Aircraft restart.
6. Aircraft are rearmed.
7. Aircraft depart FARP.



Aircraft should avoid overflying other aircraft in the FARP to minimize potential for aircraft mishaps.



Prior to aircraft departure, communication should be re-established between aircraft and FARP OIC/air boss for clearance to depart the FARP.

18.12.4.2 Initial Cold Refueling Procedures

The following steps shall be accomplished prior to aircraft entering the cold refueling area.

1. Recirculate (flush) the system or mobile refueler's hoses and take a fuel sample for quality control checks as appropriate. (refueling point operator)



Fuel shall be recirculated/flushed through the refueling hose and nozzle, and tested for contamination prior to issuing fuel each day. Fueling shall not begin until acceptable results have been obtained (see [Chapter 15](#)). Failure to provide clean, dry fuel can adversely affect safety-of-flight.

2. The area shall be policed for foreign object debris (FOD) when feasible.





3. Verify appropriate firefighting equipment is in the FARP.
4. Ensure all visual landing aids (e.g., panel markers, NVG-compatible lighting) are securely anchored/attached to the ground at the landing points. For required lighting configuration, refer to NAVAIR 00-80T-115.
5. Ensure adequate spacing has been established between the landing/refueling points (see [Figure 18-1](#)).

WARNING

- Brown-out conditions adversely decrease the safety-of-flight in the FARP. All precautionary measures should be taken to increase the safety-of-flight.
- At no time will an aircraft land or change direction so the nose is pointed toward personnel or equipment except as outlined in [paragraph 18.12.5.3, step 2](#). (See [Figure 18-1](#) for landing direction.)

Note

- Required minimum distance between assault support helicopters is 150 feet.
- The required distance of 150 feet between attack/utility helicopters on line may be reduced to 100 feet, if the situation (terrain limitations and number of aircraft) warrants it.
- The aircraft shall approach the FARP area on a safe heading, as depicted. All aircraft will land/position themselves with the nose of the aircraft placed on the landing/refueling point. Taxi directors will not be used during cold refueling procedures outlined in this section. (See [Figure 18-1](#).)

18.12.4.3 Ordnance Procedures

Once the aircraft have landed at their respective landing/refueling points, the following steps shall be performed:

1. After landing, each aircraft will be dearmed.
2. Qualified ordnance personnel shall verify all ordnance is safe prior to commencing any refueling operations. Safe ordnance is defined as the repositioning of any mechanical arming lever(s), and or any replacement of safety pin, electrical interrupt plug/pin, securing of armament switches, and/or appropriate action that renders the particular ordnance carried as safe.
3. If possible, arming and dearming routes should occur to the front of the aircraft in succession from first to last landing point (see [Figure 18-1](#)).

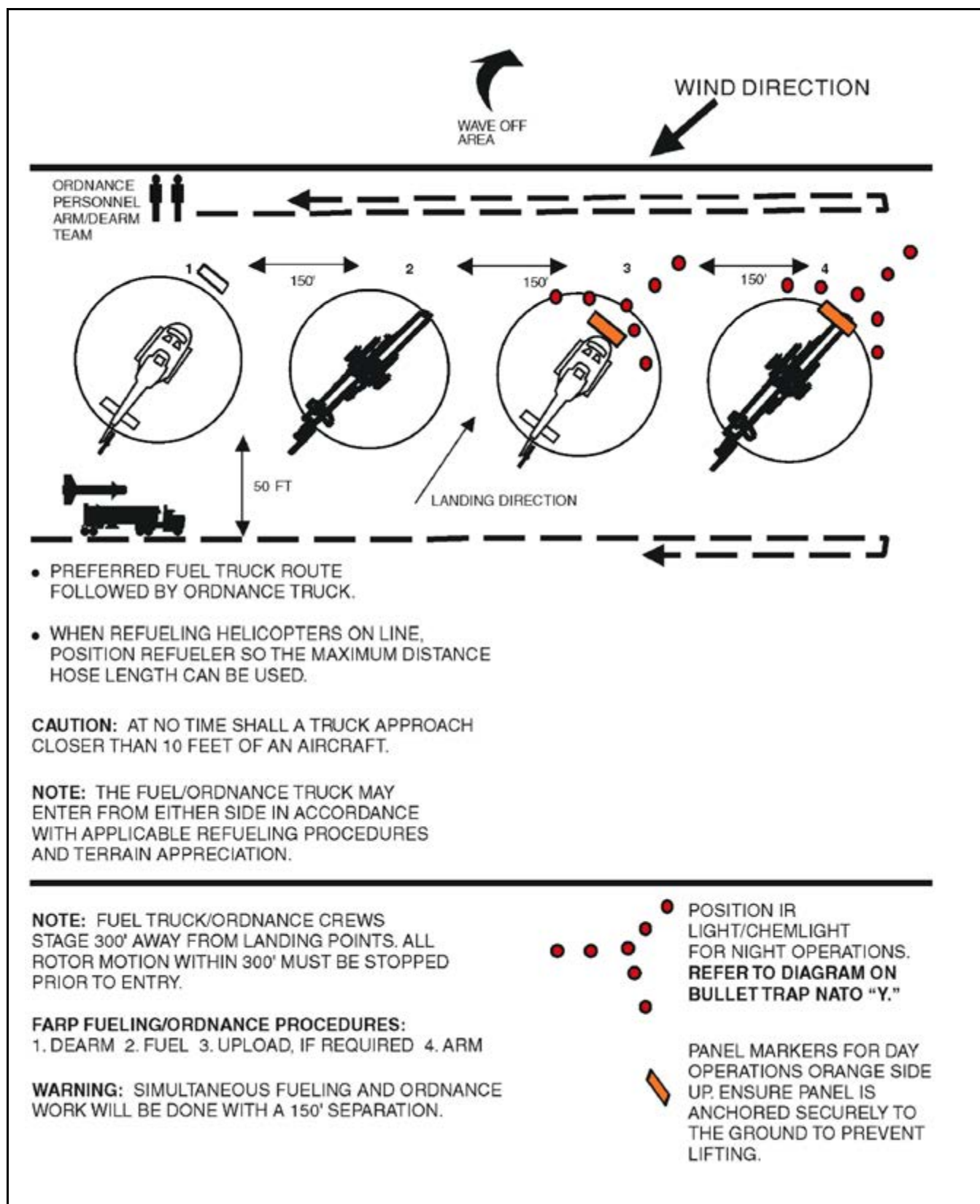
WARNING

Care shall be used to prevent personnel from passing in front of armed weapons (see [Figure 18-1](#)).





Figure 18-1. Multi-Point FARP for UH-1/AH-1 Helicopters (Cold, On Line)





4. In case of a malfunction (e.g., jammed gun) on an aircraft, operational procedures may continue on all other aircraft. However, no refueling may occur on or within 300 feet of the affected aircraft until the malfunction is cleared.
5. All Hazards of Electromagnetic Radiation to Ordnance (HERO) and High Frequency (HF) procedures will be strictly adhered to in accordance with applicable NATOPS manuals.

WARNING

- At a cold FARP, there will be no simultaneous refueling and uploading of ordnance on a single aircraft. However, either procedure may be performed on separate aircraft as long as there is a minimum of 150 feet separation between aircraft.
- Due to simultaneous fueling and uploading procedures occurring on separate aircraft, all personnel shall maintain an awareness of required distances during these phases.

18.12.4.4 Stationary System (HERS) Cold Refueling Procedures

The procedures contained in [paragraph 18.3](#) apply to cold refueling in a FARP site using a stationary (HERS) system.

18.12.4.5 Mobile Refueler (MK970/SIXCON) Cold Refueling Procedures**18.12.4.5.1 Refueler Parking Area**

Refueling vehicles shall never be left unattended when engines are operating or when refueler is in the refueling/landing area. Operators may assist in such tasks as hose handling, checking for leaks around the refueler, placing or removing grounding devices, and the actual refueling evolution.

18.12.4.5.2 Refueler Positioning

Mobile refuelers shall be positioned in the staging area so that they have an unobstructed path to and from the landing/refueling area. When terrain permits, the preferred refueler approach to the aircraft will be perpendicular to the refueling adapter. The refueler should maintain a safe distance of 50 feet, so that the maximum hose length is used during refueling; however, at no time shall a truck approach closer than 10 feet of an aircraft. Positioning between aircraft should be avoided. When the preferred approach is not possible, the refueler shall be positioned so it can be driven away quickly in case of an emergency. Preferred refueler route is illustrated in [Figure 18-1](#).

WARNING

- Mobile refuelers shall not be positioned in front of any aircraft loaded with forward firing ordnance.
- To prevent accidental contact with aircraft, equipment, or personnel during periods of reduced visibility, ground guides shall be used.

Note

Staging of mobile refuelers should be a minimum distance of 300 feet from the nearest landing/refueling point. This distance also applies when aircraft are landing in the FARP and the mobile refueler is in close proximity (conducting refueling operations). If encroachment within this minimum separation distance is unavoidable, refueling/movement of mobile refueler shall cease until adequate separation is established.





18.12.4.5.3 Pressure Refueling (Cold)

1. All nonessential personnel onboard the aircraft will disembark prior to refueling commencing.
2. Crew changes shall not occur during actual fueling of the aircraft.
3. Secure all unnecessary electronic and electrical equipment not required for refueling. (pilot/aircrew)

Once a fueling evolution has commenced, the aircraft's electrical power status and connections shall not be changed until evolution has been completed or refueling has been stopped for an emergency (e.g., no aircraft engines or APU shall be started or stopped and external power shall not be connected, disconnected, or switched on/off).

WARNING

Changing the aircraft's electrical power status can create significant ignition sources.

Note

Switching off the F-35 28V battery does not provide a hazardous ignition source and is an acceptable procedure during refueling.

4. Ensure firefighting equipment is in the immediate area of the refueling operation and manned for rapid response. (refueling point operator)
5. Zero the fueling system's meter or note the existing reading. (refueling point operator)
6. Pull out the refueling hose and hand the nozzle to the nozzle operator. The defuel hose shall not pass underneath or around the aircraft to reach the refueling receptacle. (refueling point operator)
7. Remove refueling adapter cap from the aircraft and the dust cover from the nozzle. Inspect the face of the nozzle to ensure it is clean, and verify the flow control handle is in the fully closed and locked position. (nozzle operator/refueling point operator)
8. Visually inspect the aircraft's adapter (receptacle) for any damage or significant wear. If any doubt about the integrity of the adapter exists, do not refuel.

WARNING

A worn or broken adapter can defeat the purpose of the safety interlocks of the refueling nozzle, permitting the poppet valve to open and fuel to spray or spill.

9. Ensure the nozzle bonding plug/clamp is connected/attached to aircraft prior to nozzle hookup. (nozzle operator)
10. Lift nozzle by lifting handles, align the lugs with the slots on the aircraft adapter, and hook up to the aircraft by pressing it firmly onto the adapter and rotating clockwise to a positive stop. (nozzle operator)

WARNING

Nozzle must seat on the adapter and not be canted. Canting can indicate a malfunction of the nozzle's safety interlock system, which can lead to a fuel spray or spill.



**Note**

Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. A defective or worn aircraft SPR can also be detected in this manner.

11. Rotate the nozzle flow control handle to the FULL OPEN position. The handle shall rotate 180 degrees to ensure the poppet valve is fully open and locked. (nozzle operator)

WARNING

The flow control handle of the single point pressure refueling nozzle shall be placed in either of two locked positions — fully open or fully closed. The handle is not to be used as a flag to indicate fuel flow. Excessive wear on the aircraft's adapter and the fuel nozzle poppet will result if the handle is allowed to float in the unlocked position.

12. Upon receiving signals from nozzle operator that hook-up has been completed and fueling operation is ready to begin, the refueling point operator signals the pump operator to charge the system, allowing fuel to flow to the nozzle.

WARNING

- Deadman controls are not to be blocked open or otherwise inhibited, as this will defeat the purpose of the device and can lead to a catastrophic accident.
 - Discontinue refueling immediately if any leaks are discovered throughout the operation. All repairs/maintenance will be performed away from the aircraft to avoid mishap in the event of a leak or hose rupture, etc.
13. Fuel aircraft as directed by nozzle operator. Nozzle operator shall monitor aircraft vents, tank pressure gauge(s), and/or warning lights as necessary.
 14. When directed by the nozzle operator/refueling point operator, stop the flow of fuel by using the deadman control if so equipped. (refueling pump operator)
 15. Rotate the nozzle flow control handle into the OFF and fully locked position. (nozzle operator and verified by the refueling point operator)

WARNING

Failure to lock the flow control handle in the OFF position can contribute to a failure of the nozzle's safety interlock system and could result in a fuel spray or spill.

16. Disconnect nozzle from the aircraft adapter. (nozzle operator)
17. Disconnect the bonding cable from the aircraft. (nozzle operator)
18. Disconnect the Earth ground from the aircraft, and stow away to its proper position. (nozzle operator and/or refueling point operator)
19. Replace the dust cover, stow hose and return the nozzle to its proper position. (nozzle operator and refueling point operator)





20. Complete paperwork. (refueling point operator)
21. As required, ordnance personnel will arm aircraft.
22. Once aircraft have been refueled and armed, the aircrew should contact FARP OIC/air boss for clearance to depart the FARP.

18.12.4.5.4 Overwing/Open-Port Refueling

Once the refueler is in position, conduct fueling operations as follows:

WARNING

Overwing refueling with the aircraft's engines operating is not authorized.

1. All nonessential personnel onboard the aircraft shall disembark prior to refueling commencing.
2. Crew changes shall not occur during actual fueling of the aircraft.

CAUTION

The refueling hose shall not pass underneath or around the aircraft to reach the refueling receptacle.

3. Secure all unnecessary electronic and equipment not required for refueling. (pilot/aircrew)
4. Verify firefighting equipment is in the immediate vicinity of the refueling operation and manned.
5. Zero the refueling system's meter or note the existing reading. (vehicle operator)
6. Pull out the refueling hose and place in proper position for refueling. (nozzle operator and vehicle operator)
7. Bond the overwing nozzle to the aircraft. (nozzle operator and vehicle operator).

WARNING

Always bond the nozzle to the aircraft before the cap is removed. This connection shall remain in place until the entire fueling operation is complete. Failure to bond nozzle and/or maintain contact can result in a dangerous static spark inside the fuel tank.

8. Remove the refueling cap from the aircraft and the dust cover from the nozzle. (nozzle operator)
9. Insert overwing nozzle into the aircraft's refueling port, and maintain metal-to-metal contact between the nozzle and the aircraft's refueling port throughout the entire fueling operation. (nozzle operator)
10. Upon receiving signals from nozzle operator that hook-up has been completed and fueling operation is ready to begin, refueling point operator charges the system, allowing fuel to flow to the nozzle.

WARNING

Deadman controls, where provided, shall not be blocked open or otherwise inhibited. This defeats the purpose of the device and can lead to a catastrophic accident.





11. Nozzle operator shall squeeze the handle on the overwing nozzle to initiate fuel flow and fuel aircraft. Nozzle operator shall monitor aircraft vents, tank pressure gauge(s), and/or warning lights as necessary.
12. When directed by the nozzle operator, stop the flow of fuel. (Use deadman control if being utilized.) (refueling point operator)
13. Remove the nozzle from the aircraft. (nozzle operator)
14. Disconnect bonding cable from the aircraft, and stow it away. (nozzle operator)
15. Disconnect Earth ground from the aircraft, and stow away to its proper position. (nozzle operator and refueling point operator)
16. Stow the hose, and return the nozzle to its proper position. (nozzle operator and refueling point operator)
17. Complete paperwork. (refueling point operators)
18. When necessary, ordnance personnel will arm aircraft accordingly.
19. Once aircraft have been refueled and armed, the aircrew should contact FARP OIC/air boss prior to departure.
20. Aircraft will then be cleared to depart refueling/landing points.

18.12.4.6 Refueling Aircraft with Auxiliary Power Unit (APU) Running

The aircraft APU may be used to supply electrical power for pressure refueling on military aircraft in the FARP. This operation is not considered “hot refueling”; however, the following precautions shall be observed in addition to the previous procedures.

1. One crewmember shall be located at the GTC controls within the cockpit.
2. The individual manning the required firefighting equipment shall maintain visual contact with the crewmember at the controls. When the individual manning the firefighting equipment is unable to maintain visual contact with the crewmember at the controls, an additional individual from the local fuels organization shall take position so that he has visual contact with both the crewmember at the controls and the individual manning the firefighting equipment.

18.12.5 Fueling with Engines Operating (Hot Refueling)

Hot refueling shall be performed only when operational requirements dictate the need for rapid turnaround of aircraft. The hot refueling of aircraft with ordnance requires a greater effort of coordination and is significantly more dangerous, in terms of fuel and ordnance and more costly in terms of manpower expenditures, as compared to cold refueling. However, the operational gain can be significant. Hot refueling shall be performed only with the SPR or CCR nozzles. Open-port (gravity nozzle) hot refueling is only authorized for Special Operations Forces (SOF) ([paragraph 18.12.6.6](#)).

18.12.5.1 Assault Rotary Wing FARP Hot Refueling Sequence of Events

1. All aircraft enter FARP and land in prestage area.
2. Aircraft are dearmed in the prestage area.
3. Aircraft taxi to the refueling point(s).
4. Aircraft are refueled.
5. Aircraft taxi to the post-stage area where they are armed or uploaded as required.
6. Aircraft are rearmed.
7. Aircraft depart FARP.



**WARNING**

Aircraft should avoid overflying other aircraft in the FARP to minimize potential for aircraft mishaps.

CAUTION

Prior to aircraft departure, communication should be reestablished between aircraft and FARP OIC/air boss for clearance to depart the FARP.

18.12.5.2 Initial Hot Refueling Procedures

The following steps shall be accomplished prior to aircraft entering the hot refueling area.

WARNING

Brown-out conditions adversely decrease the safety of flight in the FARP. All precautionary measures should be taken to increase safety-of-flight.

1. Recirculate (flush) the system or mobile refueler's hoses, and take a fuel sample for quality control checks as appropriate. (refueling point operator)

WARNING

- Fuel shall be recirculated/flushed through the refueling hose and nozzle, and tested for contamination prior to issuing fuel each day. Fueling shall not begin until acceptable results have been obtained (see [Chapter 15](#)). Failure to provide clean, dry fuel can adversely affect safety-of-flight.
 - No nozzle sample shall be taken after the aircraft has taxied into the designated hot refueling area. Sampling increases the possibility of a fuel spill in the presence of an ignition source.
2. The area shall be policed for Foreign Object Debris (FOD) when feasible.
 3. Verify appropriate firefighting equipment is in the FARP.
 4. Ensure all visual landing aids (e.g., panel markers, NVG-compatible lighting) are securely anchored/attached to the ground at the landing points. For required lighting configuration, refer to NAVAIR 00-80T-115.
 5. Ensure adequate spacing has been established between the prestage/post-stage and the refueling points.

WARNING

At no time will an aircraft with forward firing ordnance land or change direction so the nose is pointed toward personnel or equipment.

Note

Attack/utility spacing in the prestaging and post-staging areas will be a minimum of 100 feet apart and marked with visual landing aids.





18.12.5.3 Aircraft Entry and Procedures

Once the aircraft have been determined ready for entry into the hot refueling area, the following steps shall be performed.

1. All aircraft will land in the prestage area and be dearmed. Aircraft with aircrews and no forward firing ordnance will dearm AN/ALE units (chaff and flare dispensers) and ensure crew served weapons are clear. Qualified ordnance personnel positioned in the prestage area must dearm aircraft with explosive ordnance or without aircrews. Aircraft will then taxi to the fuel point, refuel, taxi out to the post-stage area, and rearm.
2. Assault aircraft shall enter the fuel area by hover taxi with a 45° angle slide-in with the refueling receptacle on the side of the aircraft nearest the refueling hose/nozzle. All aircraft will land/position themselves abeam of the forward most open refueling point (see [Figure 18-2](#)). Attack/utility aircraft will land/position themselves abeam of the refueling point (nose pointed slightly outboard so no forward firing ordnance is pointing at other aircraft or FARP personnel/equipment). Main rotors shall not overlap any fueling equipment in the refueling area. The integration of attack/utility aircraft (no forward firing ordnance) with assault aircraft is authorized. Aircraft will taxi parallel to the refueling points, and they will execute a 90° pedal turn to expose the refueling port to the fuel point (see [Figure 18-3](#)).

WARNING

- To minimize taxiing hazards, taxi directors shall be used.
 - Only one aircraft will hover/air taxi at a time in the FARP.
3. Prior to entry/exiting of the FARP, aircraft shall signal to the taxi director through the use of its anti-collision lights or other pre-arranged signal that they are prepared to enter/exit the FARP.
 4. The taxi director shall then acknowledge the aircraft's signal through the use of hand and arm signals.
 5. Once taxiing from point to point is completed, aircraft should turn off its lights.

WARNING

Taxi directors shall remain clear and cognizant of tail rotor-equipped aircraft operating on adjacent points.

18.12.5.4 Ordnance Procedures

1. Once aircraft land in the prestage area, qualified ordnance personnel shall verify all ordnance is safe prior to taxiing to the fuel point. Safe ordnance is defined as the repositioning of any mechanical arming lever(s), and or replacement of safety pin, electrical interrupt plug/pin, securing of armament switches, and/or appropriate action that renders the particular ordnance carried as safe.

Note

In the case of a malfunction (e.g., jammed gun), it will be the first aircraft to taxi past the FARP and proceed directly into point one of the post-stage area to be cleared. Once cleared, the aircraft will depart the FARP and reenter the prestage area.

2. Aircraft shall land as directed by air boss/FARP OIC.
3. Ordnance crew shall dearm all aircraft as directed by the air boss/FARP OIC. Personnel shall not pass in front of aircraft weapons systems.



**WARNING**

Dearming can start when ordnance personnel determine it safe, but at minimum, must wait until all aircraft adjacent to the desired aircraft have landed and at flat pitch. (To dearm aircraft at point one, the aircraft at point two must be landed and at a flat pitch; to dearm point two, the aircraft at point three must be landed and at a flat pitch; and to dearm point three, the aircraft at point four must be landed and at a flat pitch.)

4. Aircraft shall not taxi to fuel area until ordnance dearm crew has cleared the area.
5. All Hazards of Electromagnetic Radiation to Ordnance (HERO) and High Frequency (HF) procedures will be strictly adhered to in accordance with applicable NATOPS manuals.

Note

Simultaneous fueling, loading, and downloading of weapons, preloaded IMERs/ITERs, PASE weapons, and installation of fuses and arming wires is authorized as long as no electrical connections to the aircraft are made.

Figure 18-2. Standard Assault Hot FARP

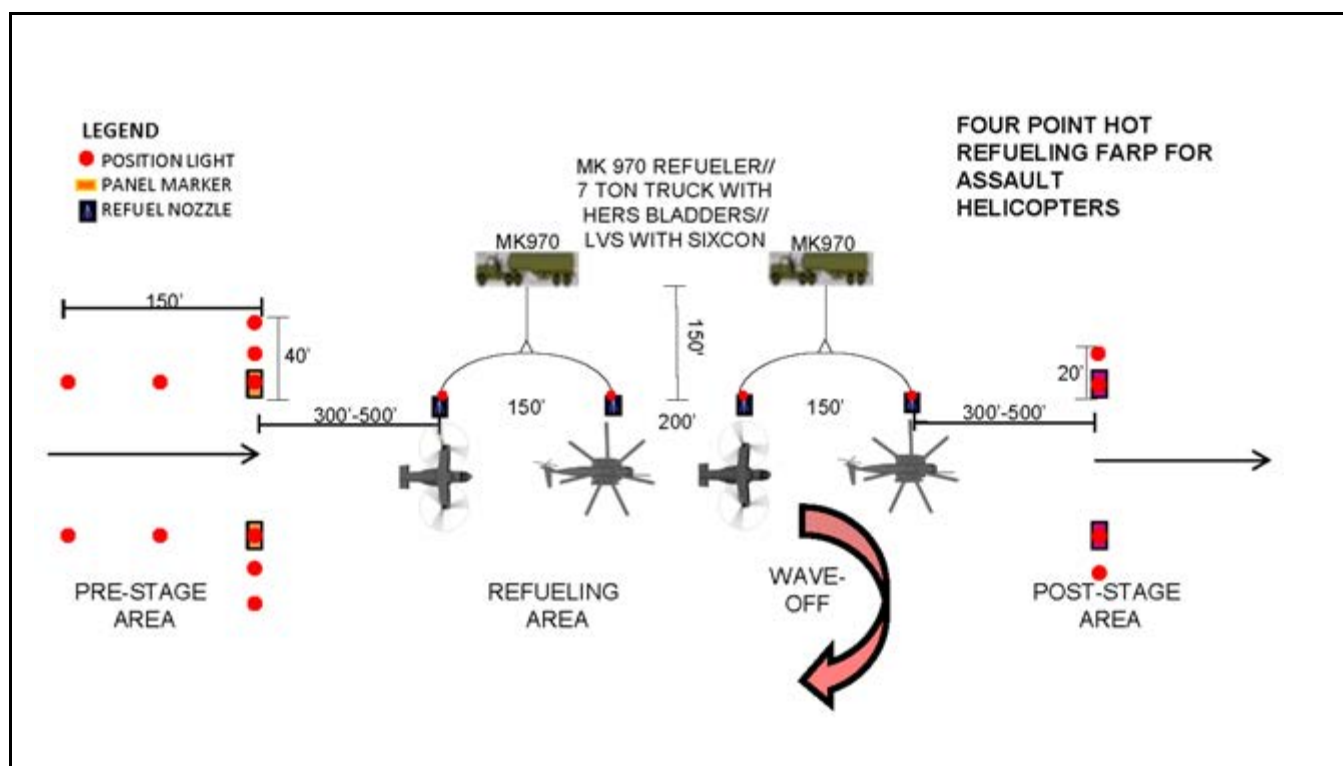
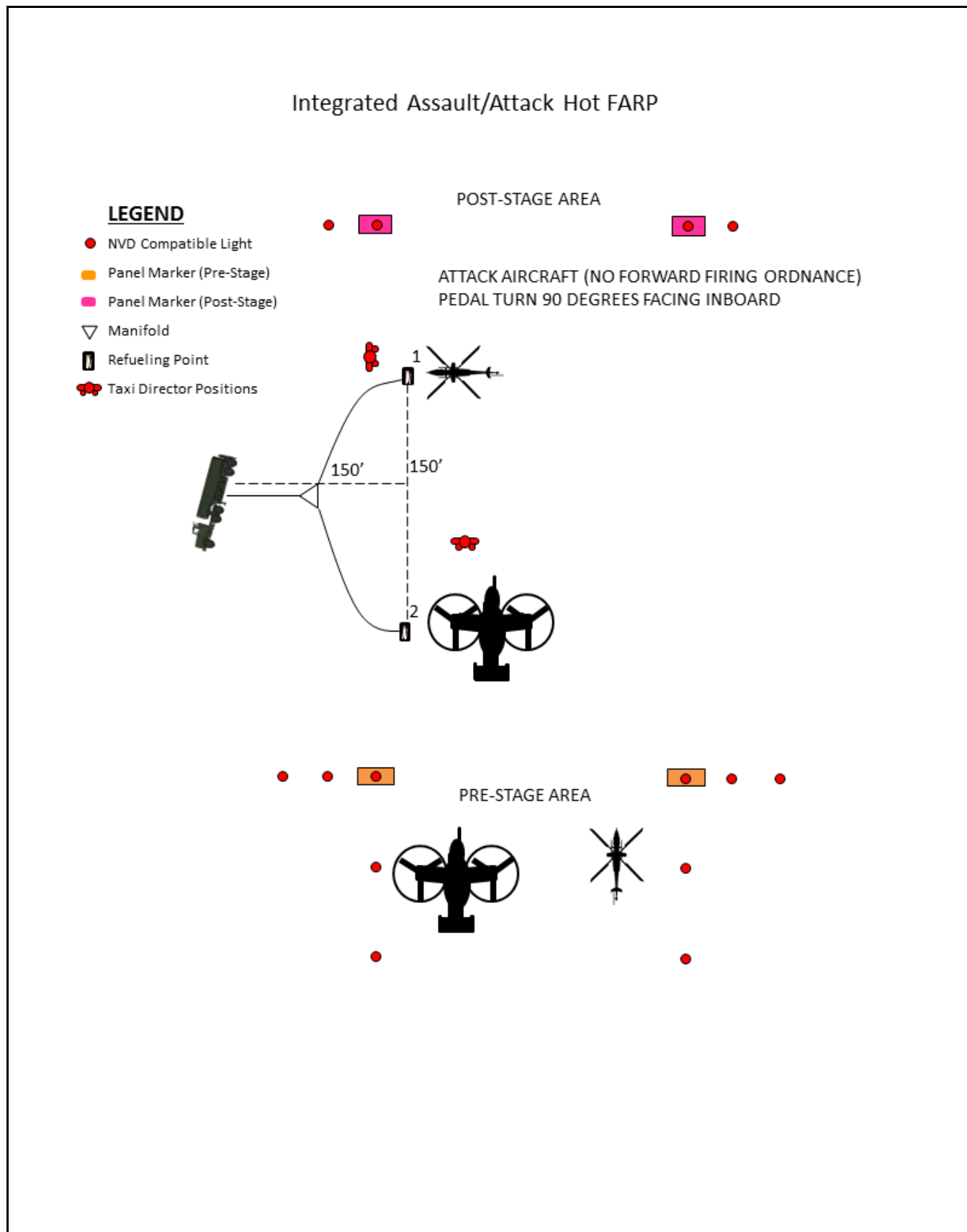




Figure 18-3. Integrated Assault/Attack Hot FARP





18.12.5.5 Hot Refueling Procedures

These procedures apply to both stationary and mobile equipment.

WARNING

Personnel onboard not essential to the mechanical function or operation of the aircraft will disembark at the fuel points and prior to refueling. A safe point will be established to muster personnel. Personnel will re-embark prior to the rearming operation.

1. Crew changes and hot seating shall not occur during actual fueling, dearming, or arming of the aircraft.

WARNING

- Rear cargo doors/windows and/or doors/windows on opposite side of aircraft from the refueling receptacle may be open provided the refueling hose is positioned so that it is unlikely fuel sprays from nozzle adapter malfunction or hose rupture will enter aircraft passenger/cargo/cockpit compartment(s).
 - Assume all engines on multi-engine aircraft are operating.
 - No engine will be restarted within 50 feet of any fuel handling equipment.
2. Pilot shall secure all unnecessary electronic and electrical equipment in accordance with respective aircraft NATOPS Manual.

Once a fueling evolution has commenced, the aircraft's electrical power status and connections shall not be changed until evolution has been completed or refueling has been stopped for an emergency (e.g., no aircraft engines or APU shall be started or stopped and external power shall not be connected, disconnected, or switched on/off).

WARNING

Changing the aircraft's electrical power status can create significant ignition sources.

Note

Switching off the F-35 28V battery does not provide a hazardous ignition source and is an acceptable procedure during refueling.

3. Ensure firefighting equipment is in the immediate area of the refueling operation and manned for rapid response. (refueling point operator)
4. Attach a grounding cable from an established Earth ground to the aircraft. (refueling point operator)
5. Zero the fueling system's meter or note the existing reading. (refueling point operator)
6. Pull out the refueling hose and hand the nozzle to the nozzle operator. The refueling hose shall not pass underneath or around the aircraft to reach the refueling receptacle. (refueling point operator)
7. Remove refueling adapter cap from the aircraft and the dust cover from the nozzle. Inspect the face of the nozzle to ensure it is clean, and verify the flow control handle is in the fully closed and locked position. (nozzle operator/refueling point operator)





8. Visually inspect the aircraft's adapter (receptacle) for any damage or significant wear. If any doubt about the integrity of the adapter exists, do not refuel.

WARNING

A worn or broken adapter can defeat the purpose of the safety interlocks of the refueling nozzle, permitting the poppet valve to open and fuel to spray or spill.

9. Ensure the nozzle bonding plug/clamp is connected/attached to aircraft prior to nozzle hookup. (nozzle operator)
10. Lift nozzle by lifting handles, align the lugs with the slots on the aircraft adapter, and hook up to the aircraft by pressing it firmly onto the adapter and rotating clockwise to a positive stop. (nozzle operator)

WARNING

Nozzle must seat on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system, which can lead to a fuel spray or spill.

Note

Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. A defective or worn aircraft SPR can also be detected in this manner.

11. Rotate the nozzle flow control handle to the FULL OPEN position. The handle shall rotate 180 degrees to ensure the poppet valve is fully open and locked. (nozzle operator)

WARNING

The flow control handle of the single point pressure refueling nozzle shall be placed in either of two locked positions — fully open or fully closed. The handle is not to be used as a flag to indicate fuel flow. Excessive wear on the aircraft's adapter and the fuel nozzle poppet will result if the handle is allowed to float in the unlocked position.

12. Upon receiving signals from nozzle operator that hook-up has been completed and fueling operation is ready to begin, refueling point operator signals the pump operator to charge the system, allowing fuel to flow to the nozzle.

WARNING

- Deadman controls are not to be blocked open or otherwise inhibited, as this will defeat the purpose of the device and can lead to a catastrophic accident.
- Discontinue refueling immediately if any leaks are discovered throughout the operation. All repairs/maintenance will be performed away from the aircraft to avoid mishap in the event of a leak or hose rupture, etc.





13. Fuel aircraft as directed by nozzle operator. Nozzle operator shall monitor aircraft vents, tank pressure gauge(s), and/or warning lights as necessary.
14. When directed by the nozzle operator/refueling point operator, stop the flow of fuel by using the deadman control if so equipped. (refueling pump operator)
15. Rotate the nozzle flow control handle into the OFF and fully locked position. (nozzle operator and verified by the refueling point operator).

WARNING

Failure to lock the flow control handle in the OFF position can contribute to a failure of the nozzle's safety interlock system and could result in a fuel spray or spill.

16. Disconnect nozzle from the aircraft adapter. (nozzle operator)
17. Disconnect the bonding cable from the aircraft. (nozzle operator)
18. Disconnect the earth ground from the aircraft and stow away to its proper position. (nozzle operator and/or refueling point operator).
19. Replace the dust cover, stow hose, and return the nozzle to its proper position. (nozzle operator and refueling point operator).
20. Complete paperwork. (refueling point operators).

18.12.5.6 Aircraft Exiting Procedure

1. Once the aircraft is fueled and nozzle is stowed, aircraft will leave the fuel point under the guidance of the taxi director in the order they came into the refueling points.
2. Aircraft will exit the fuel points one at a time and land in the post-stage to arm or upload as required.

18.12.6 Attack/Utility FARP Hot Refueling Sequence of Events

1. Flight Lead will contact air boss/FARP OIC on designated UHF frequency. Air boss/FARP OIC will direct them to the appropriate fueling point(s).
2. Flight Lead will acknowledge and head to appropriate landing points. All aircraft will approach the fuel points to the port of the refueling assets being careful not to over-fly personnel or equipment.
3. Aircraft will be dearmed and will keep the engines running.
4. Aircraft will receive fuel and ordnance as required. Air boss will determine the sequence of replenishment (fuel or ordnance) based on requirements.

WARNING

- Simultaneous refueling and ordnance operations on a single aircraft is prohibited. However, either procedure may be performed on separate aircraft as long as the distance of 300 feet between aircraft is maintained.
 - Due to simultaneous fueling and uploading procedures occurring on separate aircraft, all personnel shall maintain awareness of required distances during these phases.
5. During AH-1W hot fueling operations, the front seat pilot can exit the aircraft to assist in connecting the fuel nozzle to the aircraft and to conduct fueling checks in accordance with the AH-1W NATOPS.





6. Aircraft will be rearmed.



Once the aircraft is replenished, the aircraft will reestablish communications with air boss/FARP OIC for clearance to depart.

18.12.6.1 Initial Hot Refueling Procedures

The following steps shall be accomplished prior to aircraft entering the hot refueling area.

WARNING

Brown-out conditions adversely decrease the safety of flight in the FARP. All precautionary measures should be taken to increase safety-of-flight.

1. Recirculate (flush) the system or mobile refueler's hoses, and take a fuel sample for quality control checks as appropriate. (refueling point operator)
 - a. Fuel shall be recirculated/flushed through the refueling hose and nozzle, and tested for contamination prior to issuing fuel each day. Fueling shall not begin until acceptable results have been obtained (see [Chapter 15](#)). Failure to provide clean, dry fuel can adversely affect safety-of-flight.
 - b. No nozzle sample shall be taken after the aircraft has taxied into the designated hot refueling area. Sampling increases the possibility of a fuel spill in the presence of an ignition source.
2. The area shall be policed for Foreign Object Debris (FOD) when feasible.
3. Verify appropriate firefighting equipment is in the FARP.
4. Ensure all visual landing aids (e.g., panelmarkers, NVG-compatible lighting) are securely anchored/attached to the ground at the landing points. For required lighting configuration, refer to NAVAIR 00-80T-115.
5. Ensure adequate spacing has been established between refueling points.

WARNING

At no time will an aircraft with forward firing ordnance land or change direction so the nose is pointed toward personnel or equipment.

18.12.6.2 Aircraft Entry Procedures

Once the aircraft have been determined ready for entry into the hot refueling area, the following steps shall be performed.

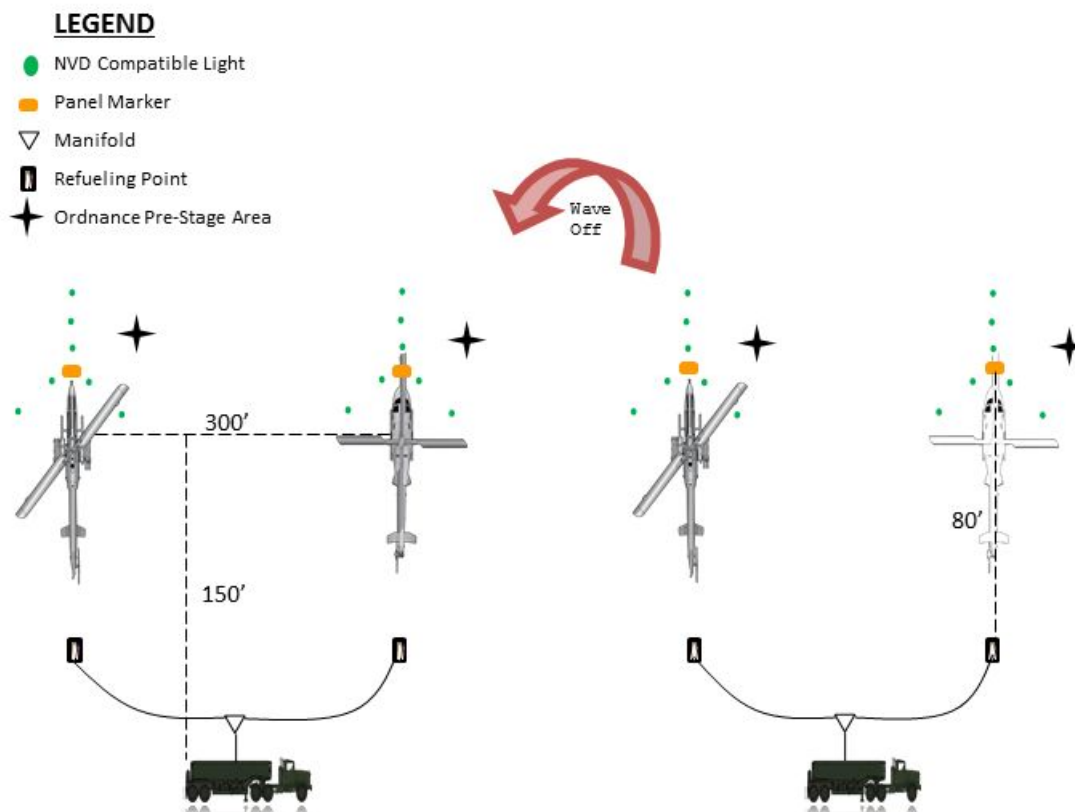
1. All aircraft will land as designated by air boss/FARP OIC. Qualified ordnance personnel will safe aircraft.
2. Attack/utility aircraft will land/position themselves abeam of the refueling point (nose pointed slightly outboard so no forward firing ordnance is pointing at other aircraft or FARP personnel/equipment). (See [Figure 18-4](#).) Main rotors shall not overlap any fueling equipment in the refueling area. The integration of attack/utility aircraft with assault aircraft is authorized.





Figure 18-4. Static FARP Layout

FOUR POINT STATIC FARP

**NOTE**

The ambidextrous setup will allow refueling without the requirement to assign refueling points to aircraft based on type/model/series.

WARNING

Personnel must remain cognizant of tail rotors during hot refueling



**WARNING**

- To minimize taxiing hazards, taxi directors shall not be used to direct aircraft with forward firing ordnance onboard.
- Only one aircraft will hover/air taxi at a time in the FARP.
- Taxi directors shall remain clear and cognizant of tail rotor-equipped aircraft operating on adjacent points.

18.12.6.3 Ordnance Procedures

1. Once aircraft land in designated point, certified and qualified ordnance personnel shall verify all ordnance is safe prior to ordnance vehicle movements to the fuel point. Safe ordnance is defined as the repositioning of any mechanical arming lever(s), and/or replacement of safety pin, electrical interrupt plug/pin, securing of armament switches, and/or appropriate action that renders the particular ordnance carried as safe.

WARNING

The initial staging area for all ordnance personnel and equipment will be a minimum of 300 feet from first or last landing point.

2. Aircraft shall land from north to south, east to west, or left to right.
3. Ordnance crew shall dearm all aircraft as directed by air boss/FARP OIC while exercising care to prevent personnel from passing in front of weapons systems.

WARNING

Dearming can start when ordnance personnel determine it safe, but at a minimum, must wait until all aircraft adjacent to the desired aircraft have landed and are at flat pitch.

4. All Hazards of Electromagnetic Radiation to Ordnance (HERO) and High Frequency (HF) procedures will be strictly adhered to in accordance with applicable NATOPS manuals.

Note

Simultaneous fueling, loading, and downloading of weapons, preloaded IMERs/ITERs, PASE weapons, and installation of fuses and arming wires is authorized as long as no electrical connections to the aircraft are made.

18.12.6.4 Hot Refueling Procedures

These procedures apply to both stationary and mobile equipment.

WARNING

Personnel onboard not essential to the mechanical function or operation of the aircraft will disembark at the fuel points and prior to refueling. A safe point will be established to muster personnel. Personnel will re-embark prior to the rearming operation.

1. Crew changes and hot seating shall not occur during actual fueling, dearming, or arming of the aircraft.



**WARNING**

- Doors/windows on opposite side of aircraft from the refueling receptacle may be open provided the refueling hose is positioned so that it is unlikely fuel sprays from nozzle adapter malfunction or hose rupture will enter aircraft passenger/cargo/cockpit compartment(s).
 - Assume all engines on multi-engine aircraft are operating.
2. Pilot shall secure all unnecessary electronic and electrical equipment in accordance with respective aircraft NATOPS Manual.

Once a fueling evolution has commenced, the aircraft's electrical power status and connections shall not be changed until evolution has been completed or refueling has been stopped for an emergency (e.g., no aircraft engines or APU shall be started or stopped and external power shall not be connected, disconnected, or switched on/off).

WARNING

Changing the aircraft's electrical power status can create significant ignition sources.

Note

Switching off the F-35 28V battery does not provide a hazardous ignition source and is an acceptable procedure during refueling.

3. Ensure firefighting equipment is in the immediate area of the refueling operation and manned for rapid response. (refueling point operator)
4. Line NCO shall be in a position to observe nozzle and refueling point operator for UH-1Y due to port side refueling and shall be conducted at point 3 and 4 because the nozzle and grounding cable need to be placed opposite of what is depicted in [Figure 18-4](#).
5. Attach a grounding cable from an established Earth ground to the aircraft. (refueling point operator)
6. Zero the fueling system's meter or note the existing reading. (refueling point operator)
7. Pull out the refueling hose and hand the nozzle to the nozzle operator. The refueling hose shall not pass underneath or around the aircraft to reach the refueling receptacle. (refueling point operator)
8. Remove refueling adapter cap from the aircraft and the dust cover from the nozzle. Inspect the face of the nozzle to ensure it is clean, and verify the flow control handle is in the fully closed and locked position. (nozzle operator)
9. Visually inspect the aircraft's adapter (receptacle) for any damage or significant wear. If any doubt about the integrity of the adapter exists, do not refuel. (nozzle operator)

WARNING

A worn or broken adapter can defeat the safety interlocks of the refueling nozzle permitting the poppet valve to be in the open position when removed from the SPR adapter and fuel to spray or spill.

10. Ensure the nozzle bonding plug/clamp is connected/attached to aircraft prior to nozzle hookup. (nozzle operator)





11. Lift nozzle by lifting handles, align the lugs with the slots on the aircraft adapter, and hook up to the aircraft by pressing it firmly onto the adapter and rotating clockwise to a positive stop. (nozzle operator)

WARNING

Nozzle must seat on the adapter and not be cocked. Cocking can indicate a malfunction of the nozzle's safety interlock system, which can lead to a fuel spray or spill.

Note

Any nozzle that can be disconnected from the SPR with the nozzle crank handle in the open position is defective and must be removed from service immediately. A defective or worn aircraft SPR can also be detected in this manner.

12. Rotate the nozzle flow control handle to the FULL OPEN position. The handle shall rotate 180 degrees to ensure the poppet valve is fully open and locked. (nozzle operator) The flow control handle of the single point pressure refueling nozzle shall be placed in either of two locked positions — fully open or fully closed. The handle is not to be used as a flag to indicate fuel flow. Excessive wear on the aircraft's adapter and the fuel nozzle poppet will result if the handle is allowed to float in the unlocked position.
13. Upon receiving signals from nozzle operator that hook-up has been completed and fueling operation is ready to begin, refueling point operator signals the pump operator to charge the system, allowing fuel to flow to the nozzle.

WARNING

- Deadman controls are not to be blocked open or otherwise inhibited, as this will defeat the purpose of the device and can lead to a catastrophic accident.
- Discontinue refueling immediately if any leaks are discovered throughout the operation. All repairs/maintenance will be performed away from the aircraft to avoid mishap in the event of a leak or hose rupture, etc.

14. Once fuel flow has been established, exercise the aircraft's precheck system. (nozzle operator)

Note

The precheck system simulates the completion of refueling by closing all of the tank shut-off valves within the aircraft. All fuel flow into the aircraft should stop within a few seconds to 1 minute of actuating the precheck system. On aircraft equipped with a fuel indicator, the primary means of detecting successful precheck is by observing the flow indicator on the aircraft to make sure that it stops. If the aircraft is not configured with a flow indicator, or if the aircraft flow indicator is inoperative, the only acceptable means of determining that precheck has been successful is to watch the fuel delivery system's flow counter (flow meter) to ensure it stops. A stiffening (or jerking) of the refueling hose or indication of a fueling pressure spike is not a suitable indication that precheck has successfully occurred (hose stiffening/jerking and pressure spikes can occur whenever one or more aircraft fuel tank refueling valves close).

15. Fuel aircraft as directed by nozzle operator. Nozzle operator shall monitor aircraft vents, tank pressure gauge(s), and/or warning lights as necessary.





16. When directed by the nozzle operator/refueling point operator, stop the flow of fuel by using the deadman control if so equipped. (refueling pump operator)
17. Rotate the nozzle flow control handle into the OFF and fully locked position. (nozzle operator and verified by the refueling system operator). Failure to lock the flow control handle in the OFF position can contribute to a failure of the nozzle's safety interlock system and could result in a fuel spray or spill.
18. Disconnect nozzle from the aircraft adapter. (nozzle operator)
19. Disconnect the bonding cable from the aircraft. (nozzle operator)
20. Disconnect the earth ground from the aircraft and stow away to its proper position. (nozzle operator and/or refueling point operator)
21. Replace the dust cover, stow hose, and return the nozzle to its proper position. (nozzle operator and refueling point operator)
22. Complete paperwork. (refueling point operators)

18.12.6.5 Aircraft Exiting Procedure

Once the aircraft is fueled, the nozzle is stowed, and the aircraft is cleared by the air boss/FARP OIC, the aircraft will exit the fuel points one at a time.

18.12.6.6 Hot Refueling Operations In Support of Special Operations (Helicopters)

Some Special Operations Forces (SOF) missions require that SOF helicopters be open-port (gravity-nozzle) hot refueled. In the event that a request for open-port hot refueling of SOF helicopters is received, refueling operations shall follow [paragraph 18.12.6](#).

Note

- When conducting FARP operations, the tactical or training requirements may necessitate both pilots exiting the aircraft without shutting down to expedite refuel or rearm. Prior to exiting the aircraft, pilots will comply with SOF unit SOPs.
- Only SOF aviation-assigned personnel will conduct overwing refueling operations at the aircraft.





CHAPTER 19

Maintenance of Tactical Fueling Equipment

19.1 GENERAL REQUIREMENTS

The maintenance and inventory of the Marine Corps tactical/deployable refueling assets shall be accomplished in accordance with current MCO P4790.2 series, TM 3835, other governing directives, and this chapter. Adherence to preventive checks and services is critical.

19.2 AIRCRAFT REFUELING EQUIPMENT CHECKLISTS

Tactical fuel system (TAFDS, HERS) checklists shall be completed in accordance with TM 3835.

Each unit shall use daily, weekly, monthly, and periodic checklists that shall cover, at a minimum, the serially numbered items listed in [Figures 13-1, 13-2, 13-3, and 13-4](#), except as noted in the following paragraphs. Refer to [Chapter 13](#) for serialized explanation of checklist items. Checklists that are published in accordance with current technical manuals that are specific to individual systems may be substituted.

19.2.1 Daily Checklist

The daily checklist ([Figure 13-1](#)) shall be completed on all aircraft fuel delivery equipment that is in continuous use, once in every 24-hour period on a not-to-interfere-with-aircraft-servicing basis.

Note

Item 9 is only required when terrain permits.

19.2.2 Weekly Checklist

In order to provide continuity to the checks of the various items, the Weekly Checklist ([Figure 13-2](#)) shall be performed by a senior operator or fuel shop personnel. The weekly inspection shall be performed on all equipment being returned to service, following any down time that exceeds 72 hours.

19.2.3 Monthly Checklist

The Monthly Checklist, [Figure 13-3](#), requires special equipment and moving of mobile equipment to a location other than the operating area.

Note

Item 4 will be conducted only if equipped.

19.2.4 Periodic Inspection and Annual Record

The Periodic Inspection and Annual Record, [Figure 13-4](#), provides an important historical record for each piece of refueling equipment. The frequencies are absolute minimums. Local conditions may require more frequent inspections. The N.R. in seasonal columns translates to needs repair and does not mean not required. The inspection items contained in this checklist are self-explanatory.

The following exceptions apply:

1. Brake linings/pads — conducted by organizational maintenance.
2. Calibrate pumps & meters — not required when forward deployed.
3. Calibrate pressure gauges — not required when forward deployed.





4. Oil change/lubricate — conducted by organizational maintenance.
5. Winterize — conducted by organizational maintenance.
6. Brake linings replaced — conducted by organizational maintenance.
7. Cabin carbon monoxide check — not required on tactical equipment.
8. Hydrostatic test of refueling hose — not required when forward deployed.





APPENDIX A

Aviation Fuels Quality Surveillance Logs, Fuels Accountability Logs, and Labels



[illegible]



Figure A-2. Aviation Fuel Contamination Fuel Detector Correlation Log

AVIATION FUEL CONTAMINATION FUEL DETECTOR CORRELATION LOG

CCFD Serial Number:				Location:			
Sample		Date Tested	Sample Serial No.	Source of Sample	Test Performed	Test Results	Difference†
Date	Time						
					In-house CFD		
					ASTM D 2276		
					In-house CFD		
					ASTM D 2276		
					In-house CFD		
					ASTM D 2276		
					In-house CFD		
					ASTM D 2276		
					In-house CFD		
					ASTM D 2276		
					In-house CFD		
					ASTM D 2276		
					In-house CFD		
					ASTM D 2276		
					In-house CFD		
					ASTM D 2276		
					In-house CFD		
					ASTM D 2276		
					In-house CFD		
					ASTM D 2276		
					In-house CFD		
					ASTM D 2276		
					In-house CFD		
					ASTM D 2276		
					In-house CFD		
					ASTM D 2276		
					In-house CFD		
					ASTM D 2276		
					In-house CFD		
					ASTM D 2276		

†If the difference is greater than 0.8 mg/l, immediately notify supervisor/manager.





Figure A-3. Aviation Fuel B/2 Test Kit (FSII) Correlation Log

AVIATION FUEL B/2 TEST KIT (FSII) CORRELATION LOG

				Location:			
Sample		Date Tested	Sample Serial No.	Source of Sample	Test Performed	Test Results	Difference†
Date	Time						
					In-house FSII		
					Central Lab FSII		
					In-house FSII		
					Central Lab FSII		
					In-house FSII		
					Central Lab FSII		
					In-house FSII		
					Central Lab FSII		
					In-house FSII		
					Central Lab FSII		
					In-house FSII		
					Central Lab FSII		
					In-house FSII		
					Central Lab FSII		
					In-house FSII		
					Central Lab FSII		
					In-house FSII		
					Central Lab FSII		
					In-house FSII		
					Central Lab FSII		
					In-house FSII		
					Central Lab FSII		
					In-house FSII		
					Central Lab FSII		
					In-house FSII		
					Central Lab FSII		

†If the difference is greater than 0.03 percentage points, immediately notify supervisor/manager.





Figure A-4. Aviation Fuel Sample Label


AVIATION FUEL TEST SAMPLE

Originating Activity: _____

Sample Serial No.: _____

Type of Fuel: _____

Date Sample Taken: _____

Time Sample Taken: _____

Source of Sample: _____

Sample by: _____

Sample Classification and Tests Requested:

☐ Routine Monthly Correlation Sample

<u>Test to be performed by Regional Lab.</u>	<u>Originating Activity's Results</u>
☐ Sediment/Particulates (ASTM D 2276)	_____ (by CFD)
☐ FSII by B/2 Test Kit	_____ (by B/2)
☐ Flash Point	_____

☐ Special Sample

☐ Test Required: _____

☐ Remarks: _____

Refuel-F051





AVIATION FUEL QUALITY LABORATORY REPORT FORM											
From: (Testing Laboratory's Name and Address)						Report Date: _____ Date of Testing: _____ Date Samples Received: _____					
To: (Activity's Name and Address Submitting Samples)											
Fuel Type: ____ JP-5 ____ JP-8 ____ JP-4 ____ AVGAS ____ F-24 ____ Other											
Sample		Source of Sample	Test Results							API Gravity (If Required)	Remarks
#	Date		Appearance	Sediment/ Particulates		FSII		Flash Pt			
				S A. *	Lab **	S A. *	Lab **				

* S A. — Submitting Activity's Results ** Lab — Testing Laboratory's Results on Duplicate Correlation Sample



Figure A-6. Shipboard Fuel Sample Log

[illegible]

A-7

ORIGINAL



ORIGINAL

SUPERVISOR _____ CPO _____ MAINTENANCE OFFICER _____

DATE _____

[illegible]

TOTAL RUN TIME THIS PAGE: _____

Refuel-F055

SUPERVISOR _____ B/D CPO _____ MAINTENANCE OFFICER _____

ORIGINAL

FIGURE A-9
NAVAIR OO-80T-109



Figure A-10. Refueling Card

[illegible]

FIGURE A-10
NAVAIR 00-80T-109





Figure A-11. V-4 Division Daily Fuels Report

SHIPS LOGO		SHIPS NAME							
V-4 DIVISION DAILY FUELS REPORT									
(MANUALLY ENTERED DATA IS THIS COLOR)									
		JP-5			LUBE OIL		MOGAS		
		GALLONS	PERCENT	BARRELS	GALLONS	PERCENT	GALLONS	PERCENT	
TOTAL WORKING CAPACITY									
100% TOTAL CAPACITY									
100% SAFE OPERATING CAPACITY			100%			100%		100%	
95% SAFE OPERATING CAPACITY			95%			95%		95%	
INVENTORY		GALLONS	PERCENT	BARRELS	GALLONS	PERCENT	GALLONS	PERCENT	
PREVIOUS PHYSICAL ON-HAND INVENTORY:									
+ TOTAL RECEIVED (UNREP/ASHORE)									
+ TOTAL DEFUELED									
- TOTAL ISSUED									
BOOK ON-HAND INVENTORY:									
- PHYSICAL ON-HAND INVENTORY									
DIFFERENCES (BOOK-PHYSICAL OIH)					Gain/Loss Explanation				
A. Determinable Loss - Total Stripped					(e.g. Daily Stripping)				
B. Undeterminable Gain or Loss - Operation					(e.g. Sounding/TLI reading differences)				
C. Determinable Gain or Loss - Survey 1					(e.g. Oil Spill, Pipeline leak, Fire, Flooding, Enemy Action)				
D. Determinable Gain or Loss - Survey 2					(e.g. Oil Spill, Pipeline leak, Fire, Flooding, Enemy Action)				
JP-5 ISSUE/TRANSFER/OFFLOAD									
ISSUE/TRANSFER/OFFLOAD FOR:		TODAY'S ISSUES	TODAY'S DEFUELS	ISSUES - DEFUELS	AMPLIFYING INFORMATION				
ISSUE: SHIP'S OWN USE	INCINERATOR								
	GSE								
	EDG								
	SMALL BOATS								
	JET TEST CELL								
ISSUE: EMBARKED SQUADRON AIRCRAFT	VFA -								
	VFA -								
	VFA -								
	VFA -								
	VFA -								
	VAQ -								
	VAW -								
	VRC -								
	HSC(F) -								
ISSUE: TRANSIENT SQUADRON AIRCRAFT	HSC(H) -								
	HSC -								
	HSL -								
	VFA -								
	VFA -								
	VAQ -								
ISSUE: DOD, FAS AIRCRAFT	VAW -								
	VRC -								
	HSC(F) -								
	HSC(H) -								
TRANSFER: OTHER SHIPS	NARU Reserve Squadron-								
	U.S. Coast Guard								
OFFLOAD:	U.S. Army								
	U.S. Air Force								
	Foreign Armed Service								
	CVN-, LHA-, LPD-								
	CGN-, DDG-,								
	Ashore DFSP								
TOTAL:									
REMARKS: (For JP-5 Receipt, enter: issued/transferred quantity relayed by the issuing activity - XXXXXXXX GL)									
SUBMITTED BY:			REVIEWED BY:			APPROVED BY:			
(PRINT)			(PRINT)			(PRINT)			
(SIGNATURE)			(SIGNATURE)			(SIGNATURE)			
COPY TO: COMMANDING OFFICER/ V-4 OFFICE/ MAINT/ AIR OFFICE/ HANDLER OPERATIONS/ STRIKE OPERATIONS/S-1 SUPPLY/ DCA/ DC CENTRAL/CAG MAINTENANCE									

FIGURE A-11
NAVAIR 00-80T-109



APPENDIX B

Aviation Fuel Deterioration Use Limits

Figure B-1. Deterioration Use Limits for Aviation Turbine Fuels and Aviation Gasoline (Specifications MIL-DTL-5624, MIL-DTL-83133, and ASTM D910)

PROPERTY	SPECIFICATION REQUIREMENT	USE LIMIT ¹	ASTM TEST METHOD
ALL TURBINE FUELS (JP-5, JP-8, JP-4, F-24)			
Existent Gum, mg/100 ml, max	7	14	D 381
Corrosion, Copper Strip, 2 hours at 100 °C (212 °F), max	1	Note 2	D 130
Sediment/Particulate Matter, mg/l, max	1.0	2.0	D 2276, D5452 or CFD
Distillation Residue, % max, V/V	1.5	2.0	D 86
FSII, % Volume	0.10 – 0.15	0.04 – 0.20 ³	D 5006 ⁴
JP-5, NATO Code F-44			
Flash Point °C (°F), min	60 (140)	60 (140) ⁵	D 93 or D6450
API Gravity, °API, min – max	36.0 – 48.0	36.0 – 48.0	D 1298 or D4052
Distillation, % fuel recovered at 205 °C (400 °F)	10	7	D 86
Peroxide number, ppm, max	8.0	16.0	D 3703
WSIM, min	Note 6	Note 7	D 3948
Filtration time, minutes, max	15	30 ⁸	Note 9
JP-8, NATO Code F-34, F-24 (NATO Code F-24)			
Flash Point °C (°F), min	38 (100)	32 (90)	D 93 or D6450
API Gravity, °API, min – max	37.0 – 51.0	37.0 – 51.0	D 1298 or D4052
WSIM, min	Note 10	Note 7	D 2550
Electrical Conductivity pS/m, allowable range	150 – 600	100 – 700	D 2624 or D 4308
Filtration time, minutes, max	15	20 ⁸	Note 9
JP-4, NATO Code F-40			
API Gravity, °API, min – max	45.0 – 57.0	45.0 – 57.0	D 1298 or D4052
RVP @ 37.8 °C kPa (psi @ 100 °F)	14.0 – 21.0 (2.0 - 3.0)	10.4 – 22.5 (1.5 - 3.2)	D 323, D4953, D5190 or D5191
WSIM, min	Note 10	Note 7	D2550
Electrical Conductivity pS/m, allowable range	150 – 600	100 – 700	D 2624 or D 4308





Figure B-1. Deterioration Use Limits for Aviation Turbine Fuels and Aviation Gasoline (Specifications MIL-DTL-5624, MIL-DTL-83133, and ASTM D910) (cont.)

PROPERTY	SPECIFICATION REQUIREMENT	USE LIMIT ¹	ASTM TEST METHOD
Filtration time, minutes, max	10	15 ⁸	Note 9
AVGAS (100LL), NATO Code F-18			
Knock Rating, Lean/Rich ¹¹	100.0/130.0	99.0/129.0	D909 or D2700
Color	Blue	Unlimited	D2392
API Gravity, °API, min – max	Not Specified	60 – 75	D1298 or D4052
Existent Gum, mg/100 ml, max	3.0	6.0 ¹²	D381
Distillation: % evaporated at 75 °C (167 °F) % evaporated at 105 °C (221 °F) % evaporated at 135 °C (275 °F) End Point max Residue, % max v/v	10 – 40 50 min 90 min 170 °C (338 °F) 1.5	8 – 40 47 min 87 min 350 °F ¹³ 2.0	D86
RVP @ 37.8 °C kPa (psi @ 100 °F)	38.0 – 49.0 (5.5 – 7.0)	34.5 – 50.0 (5.0 – 7.25)	D323, D5190 or D5191
Water Reaction Test, Interface rating max	2	2	D130
TEL Content, g lead/liter (ml/gal) max	0.56 (2.00)	0.60 (2.14)	D3341 or D5059
Corrosion, Copper Strip @ 100 °C (212 °F), max	1	Note 2	D130
Sediment/particulate Matter (mg/l, max)	Not Specified	2.0	D4176 ¹⁴

NOTES:

1. All physical and chemical properties not listed must fully meet the requirements of MIL-DTL-5624 for JP-5 or JP-4, MIL-DTL-83133 for JP-8, or ASTM D910 for AVGAS 100LL.
2. Under certain conditions, NAVAIR may authorize the use of jet fuel having a corrosion rating of 2 or greater by not exceeding 3a. This depends on quantity involved, location and mission of aircraft, cause of corrosion, and evaluation of complete specification test data. Forward details to NAVAIR 4.4.5 for evaluation.
3. This use limit applies to USAF and U.S. Army aircraft only. The use limit for NATO aircraft is 0.07 volume percent. Only two U.S. Navy and Marine Corps aircraft need FSII and their minimum use limit is 0.03 volume percent. See discussion in text of [Chapters 3](#) and [9](#) and [15](#) for more details.
4. Additional test methods for FSII content are the B/2 Anti-Icing Additive Refractometer and Test Kit and methods 5327 or 5340 of Federal Test Method Standard Number 791.
5. JP-5 must have a flash point of at least 140 °F for issuance to a naval ship or for defueling from an aircraft into a ship's storage system.
6. At the time of manufacture, the minimum water separation index, modified (WSIM), rating for JP-5 shall be 90 with only antioxidant and metal deactivator (if used) additives present, or 85 with all additives except the corrosion inhibitor/lubricity improver additive present, or 80 with all additives except the fuel system icing inhibitor present, or 70 with all additives present.
7. NAVAIR considers WSIM to be a refinery check on the relative cleanliness of all turbine fuels with regard to surfactant materials which may disarm filter/separators. Once all required additives have been injected into JP-5, JP-4, and JP-8, the WSIM often drops below 70. It is not a reliable method for determining whether a fuel has picked up any surfactant materials during transport and storage within the supply/distribution network. NAVAIR, therefore, does not impose a use limit for WSIM on fuels once they have left the refinery.





Figure B-1. Deterioration Use Limits for Aviation Turbine Fuels and Aviation Gasoline (Specifications MIL-DTL-5624, MIL-DTL-83133, and ASTM D910) (cont.)

NOTES (cont.):

8. Under certain conditions, NAVAIR may authorize the use of jet fuel having filtration times in excess of 30 minutes; however, it must be noted that high filtration time fuel will significantly reduce the life of filter/separators. The pressure drops across these filters must be monitored frequently whenever high filtration time fuel is encountered.
9. A minimum sample size of one gallon shall be filtered. Filtration time will be determined in accordance with the procedure in Appendix A of MIL-DTL-5624.
10. The minimum WSIM rating for JP-4 and JP-8 shall be 85 with all additives except corrosion inhibitor/lubricity improver additive and static dissipater additive present or 70 with all additives present except for the static dissipater additive.
11. AVGAS shall not be approved for use on the basis of a lean knock rating alone. The rich knock rating must also be determined. Experience has shown that, upon procurement, many fuels test above specification on the lean knock rating, and as little as 1% contamination with other products will reduce the rich knock rating 3 numbers while reducing the lean knock rating only 1 number.
12. When the existent gum non-volatile residue is greater than the maximum specified in the table, but less than 100 milligrams, and is "oily" in nature, the residue shall be treated with n-heptane as prescribed for motor gasoline in ASTM D381. If the weight of the n-heptane washed gum residue remaining is less than the maximum residue allowed in the table, the fuel may be considered as passing the requirement.
13. When the end point is above 338 °F, then lean and rich knock ratings must be determined.
14. Visual inspection is considered an acceptable method for determining the presence of unacceptable levels of particulate and free water contamination in AVGAS. The Combined Contaminated Fuel Detector (CCFD) electrical components are not rated for use with AVGAS and cannot be used for this application.





APPENDIX C

Aviation Fuel Division Continuing Training Syllabus

1. Catapult lube oil system.
 - a. Introduction to system.
 - b. Catapult lube oil tanks.
 - c. Fill/transfer piping and procedures.
 - d. Pumps and strainers.
 - e. Fill/transfer procedures.
 - f. Communications.
2. Hazards.
 - a. MOGAS characteristics and precautions.
 - (1) Receiving/offloading procedures.
 - b. JP-5 characteristics and precautions.
 - c. Pollution prevention.
3. JP-5 system.
 - a. JP-5 tanks.
 - b. Tank level indicators.
 - c. Transfer system and operating procedure.
 - d. Stripping systems and operating procedures.
 - e. Service system and operating procedures.
 - f. Auxiliary system and operating procedures.
 - g. Below Decks Console Operation.
 - h. Flight Deck Console Operation (Central Control Room).
 - i. Limitorque valves: Operations and maintenance.
 - j. Target Rock valves.
 - k. TriTec valves.
 - l. Honeywell Electric Valve Operators (EVO).
 - m. Transfer/Stripping two-speed pumps operations and interlocks.
 - n. Service Stripping/Auxiliary two-function pumps operations and interlocks.
 - o. Replenishment procedures.





- p. Settling and stripping procedures.
 - q. Rotary vane pumps sleeved and unsleeved.
 - r. Double diaphragm and internal gear pumps.
 - s. Centrifugal pumps.
 - t. Tank cleaning procedures and CCIMS.
 - u. Tank sounding procedures.
 - v. Jet engine test system.
 - w. Filter separators.
 - x. Pump/filter room ventilation system.
 - y. Reclamation system.
 - z. Emergency evacuation of spaces.
 - aa. Ballasting/deballasting JP-5 stowage tanks.
 - ab. Centrifugal purifiers.
4. Aircraft refueling equipment and procedures.
- a. Aviation refueling station description.
 - b. CV Flight/Hangar NATOPS 00-80T-120 (Aircraft Fuels Sections).
 - c. Aircraft refueling/defueling procedures and safety precautions.
 - d. Refueling station operation.
 - e. Refueling nozzles and probe adapters.
 - f. NAVAIR 00-80T-109 (Aircraft Refueling NATOPS Manual).
 - g. MIL-HDBK-844B(AS) (Aircraft Refueling Handbook).
 - h. Fueling station continuity system.
 - i. Portable defueling cart.
 - j. Aircraft-to-Aircraft Fuel transfer cart.
 - k. Hot refueling procedures.
 - l. Flight/hangar deck emergency procedures.
 - m. NAVAIR 00-80T-113 (Aircraft Signals NATOPS Manual).
 - n. Fuel Control Valve (FCV).
 - o. Eductor Isolation Valve (EIV).
 - p. Eductor Mode Switch (EMS).
 - q. Surge relief valve.
 - r. Eductor with vacuum breaker.
 - s. Simulated nozzle pressure transducer.
 - t. Flow meter with straightening vanes.
 - u. Dedicated Local Control Station (DLCS).





- v. SMAR pressure transducer.
5. Aviation fuels equipment repair.
- a. Repair party organization.
 - b. Use/care of hand and measuring tools.
 - c. Aircraft refueling nozzle maintenance.
 - d. JP-5 defueling pumps.
 - e. Patching/plugging aviation fuels piping.
 - f. In-port and underway replenishment.
 - g. Aviation fuels station ventilation.
 - h. Aviation fuels maintenance safety precautions.
 - i. Fuel hose repair.
 - j. CLA-VAL maintenance.
6. Aviation fuels quality surveillance.
- a. Maintaining quality of aviation fuels.
 - b. Operation/maintenance of AEL MK I/II Free Water Detector.
 - c. Operation, calibration and maintenance of Combined Contaminated Fuel Detector (CCFD).
 - d. Operation/maintenance of NAVIFLASH.
 - e. API gravity testing.
 - f. B-2 anti icing test kit (FSII testing).
 - g. Aviation fuel sampling, testing and reporting.
 - h. Operation/maintenance of Pensky-Marten flash point tester.
 - i. Aviation fuel sampling/testing safety.
 - j. In-port/underway replenishment fuel quality standards and testing.
7. Pump/filter room firefighting equipment.
- a. CO₂ fixed flood system and portable extinguishers.
 - b. PKP dry chemical extinguishers.
 - c. Bilge sprinkler system.
 - d. Aqueous Film Forming Foam (AFFF) system.





APPENDIX D

Authorized Air Station Aircraft Refueling System Components

1. The following list of aircraft refueling system components consists of those items identified in [paragraph 11.2](#) as critical to system safety and operations.
2. The list presents the components by component type (to include a short description of use), name of manufacturer, item name or part number, NSN (where one is established), applicable specification/standard/qualified products list, and applicable usage notes.

Figure D-1. Authorized Air Station Aircraft Refueling System Components

COMPONENT TYPE	MANUFACTURER	ITEM NAME/ PART NO.	NSN	SPEC/STD/QPL
1. Refueling Nozzles				
a. Single Point Refueling (SPR) type		Used to pressure refuel aircraft via the SPR refueling adapter. D-1 style nozzles have a 45° inlet; D-2 style nozzles have a straight inlet. D-3 style nozzles have a variable inlet which swivels to allow the inlet to be aligned in a D-1 or a D-2 configuration.		
(1) D-1 (Note 1) (Note 2a)	Carter Ground Fueling	64201H	4930-01-484-5919	QPL-AS5877 (Note 3)
	Cla-Val	341GF (D-1)	4930-01-483-8060	QPL-AS5877
		347GF (D-1)	Not assigned	QPL-AS5877
	Whittaker Ground Fueling	F1116ES	4930-01-458-5914	QPL-AS5877
(2) D-2 (Note 2b)	Carter Ground Fueling	64201J	Not assigned	QPL-AS5877
	Cla-Val	341GF (D-2)	Not assigned	QPL-AS5877
		347GF (D-2)	Not assigned	QPL-AS5877
	Whittaker Ground Fueling	F1116ER	4930-01-318-1479	QPL-AS5877
(3) D-3	Carter Ground Fueling	64201N	4930-01-544-1945	QPL-AS5877
	Cla-Val	341GF (D-3)	Not assigned	QPL-AS5877
		347GF (D-3)	Not assigned	QPL-AS5877
(4) D-1R type (Note 4)	D-1 nozzle having a 55 psi Hose End Pressure Regulator (HEPR) attached. The D-1 nozzle and HEPR are ordered separately and assembled by the using unit to make a D-1R nozzle assembly.			
(5) D-2R type (Note 4)	D-2 nozzle having a 55 psi Hose End Pressure Regulator (HEPR) attached. The D-2 nozzle and HEPR are ordered separately and assembled by the using unit to make a D-2R nozzle assembly.			
(6) D-3R type (Note 4)	D-3 nozzle having a 55 psi Hose End Pressure Regulator (HEPR) attached. The D-3 nozzle and HEPR are ordered separately and assembled by the using unit to make a D-3R nozzle assembly.			





Figure D-1. Authorized Air Station Aircraft Refueling System Components (cont.)

COMPONENT TYPE	MANUFACTURER	ITEM NAME/ PART NO.	NSN	SPEC/STD/QPL
b. Closed Circuit Refueling (CCR) type (Note 5)		Used to pressure refuel USN TH-57/MH-60R/MH-60S and selected US Army Helicopters via a CCR refueling adapter.		
	Aeroquip	AE83206R	4930-01-194-2625	MIL-PRF-52747F(AT) (Note 6)
	Carter Ground Fueling	64017	4930-01-363-6449	MIL-PRF-52747F(AT) (Notes 6 & 7)
	Wiggins	CCN101/14	4930-00-117-4726	MIL-PRF-52747F(AT)
c. Gravity (Overwing) type		Used to refuel aircraft via gravity fill ports.		
	Carter Ground Fueling	64014	4930-01-516-0839	(Note 8)
	OPW Fueling Components	295AF	4930-01-293-4472	(Notes 9, 10 & 11)
2. Hose End Pressure Regulators (HEPR) (Note 12)		Used with SPR-type pressure refueling nozzles. Maintain nozzle outlet pressure within +/- 5 psi of the nominal spring rating. Control surge pressures generated by closure of valves in the refueling system or onboard the aircraft.		
	Carter Ground Fueling	44646-55	4820-01-337-9238	(Notes 13 & 14)
	Cla-Val	343GF (p/n 2994055J)	Not assigned	(Note 13)
		348GF		
	Whittaker Ground Fueling	F595	Not assigned	(Note 13)
3. Drybreak Quick Disconnects		Allows nozzles to be attached to, or detached from, hoses with minimal or no fuel spillage.		
	Aeroquip	AE985		(Note 15)
		-16U- male half of 17U/17V	4730-01-015-9208	
		-17U - 3" female coupler	4730-01-015-9209	
		-17V -4" female coupler	4730-01-034-5391	
	Carter Ground Fueling	61154		(Note 15)
		AEL- complete QD; 3" NPT inlet; 40 mesh screen	4730-01-366-7215	
		AEP- complete QD; 2" NPT inlet; 40 mesh screen	4730-01-366-9406	





Figure D-1. Authorized Air Station Aircraft Refueling System Components (cont.)

COMPONENT TYPE	MANUFACTURER	ITEM NAME/ PART NO.	NSN	SPEC/STD/QPL
		EP - complete QD; 2" NPT inlet; no screen	4730-01-306-6328	
		BEH - complete QD; 2 1/2" NPT inlet; 60 mesh screen	4730-01-353-8497	
	Cla-Val	344GF	Not assigned	(Note 17)
		349GF	Not assigned	(Note 17)
	Staubli	HCB-28/L	Not assigned	(Note 16)
		(1 1/2" NPT female & male connections)		
	Whittaker Ground Fueling	F596	Not assigned	(Note 15)
		(2", 2 1/2" & 3")		
4. Emergency Dry Breakaway Coupling (EDBC)		Used to increase hot-refueling safety. Allows aircraft and/or refueling vehicle to egress hot refueling area in case of fuel spill or fire.		
	Aeroquip	AE81284T	4730-01-326-3063	(Note 18)
		AE96442R	4730-01-304-9631	(Note 19)
	Argo-Tech	64121	Not assigned	
		64226	2910-01-547-7550	
		64227	Not assigned	
	Cla-Val	346GF	Not assigned	
5. Pantograph Swivels				
	Aeroquip	Single plane swivel	Not assigned	
	Carter Ground Fueling	Single plane swivel 2-plane swivel	Not assigned	
	Chicksan (FMC)	2-plane swivel	Not assigned	
	Cla-Val	2-plane swivel	Not assigned	
	EMCO-Wheaton	Single plane swivel	Not assigned	





Figure D-1. Authorized Air Station Aircraft Refueling System Components (cont.)

NOTES:

1. The D-1R nozzle is the standard Navy/Marine Corps refueling nozzle. For those bases that refuel significant numbers of commercial aircraft (or their militarized equivalents) where the SPR adapter is located on the underside of the wing, the D-2R, or D-3R nozzle may be used in order to prevent excess stress on the SPR adapter.
2. Nozzle NSNs:
 - a. The generic D-1 refueling nozzle NSN is 4930-00-310-4858. If a nozzle is ordered using this NSN, a Whittaker F1116ES will be delivered.
 - b. The generic D-2 refueling nozzle NSN is 4930-01-318-1479. If a nozzle is ordered using this NSN, a Whittaker F1116ER will be delivered.
3. Variants of the older Carter 64349 nozzles may continue to be used. Other older model Carter pressure refueling nozzles shall be replaced as soon as practicable.
4. Each SPR-type pressure refueling nozzle assembly is required to include a HEPR for refueling at Navy/Marine Corps air stations. For defueling operations, D-1/D-2/D-3 nozzles may be used at the discretion of the base Fuels Officer.
5. 15-psi pressure regulation. Not carried as standard equipment on USN ships. When US Army helos equipped with CCR refueling adapters will be operating onboard USN ships the Army helo squadron must supply its own 15 psi CCR nozzle.
6. Both Aeroquip and Carter Ground Fueling make 45-psi regulated HIFR nozzles that look like the 15-psi version CCR nozzles; 45-psi regulated HIFR nozzles can be attached to standard CCR refueling fittings/receptacles. 45-psi regulated HIFR nozzles are not authorized for refueling USN TH-57 or US Army helos; they are authorized for refueling USN MH-60R/S helos.
7. Carter Ground Fueling commercial CCR nozzle, p/n 64018, may be used.
8. Adapter that converts Carter CCR refueling nozzle into gravity (overwing) refueling nozzle.
9. The OPW 295AF is the standard gravity refueling nozzle for use at USN/USMC air stations.
10. This nozzle has a 1 ½" NPT inlet connection and a 1 ½" spout. If a gravity nozzle having a 2" NPT inlet connection and a 1 ½" spout is required, an MD-3 style gravity nozzle can be ordered using NSN 4930-01-022-7901.
11. The commercial equivalent OPW nozzle is model number 295SAC having a 1 ½" NPT inlet and a 1 ½" spout.
12. 55-psi regulation is the standard for HEPRs. HEPRs having a lower nominal control rating may be used at the discretion of the base Fuels Officer.
13. Besides the 55 psi standard rating, HEPRs are available in the following lower nominal control ratings from the HEPR manufacturers:

Carter Ground Fueling	45 psi, 35 psi (replace "55" in the model number with the desired control rating when ordering)
Cla-Val	45 psi (p/n 2994045K), 35 psi (p/n 2994035A)
Whittaker Ground Fueling	50 psi, 45 psi, 35 psi (contact company for ordering specifics)

14. Carter Ground Fueling HEPRs are also available with end fittings to connect to other manufacturer's SPR-type nozzles.
15. Primarily for use with SPR-type pressure refueling nozzles; may also be used with CCR and gravity type refueling nozzles. Female half of coupling connects to refueling hose; male half of coupling connects to refueling nozzle. Female half of coupling seals when male half is disconnected.
16. For use with gravity (over-wing) nozzles. QD has 1.5-in NPT connections. Female half of coupling connects to refueling hose; male half of coupling connects to refueling nozzle (ref [paragraph 11.3.1](#)). Both halves of coupling seal when disconnected.
17. Strainer ball valve; for use as an alternative to the traditional drybreak quick disconnect. Bolts to the nozzle inlet and connects to the female half of the QD. When the strainer needs to be checked or removed for cleaning, a valve turn seals the inlet and simultaneously rotates the strainer towards the side port for inspection, which can be fitted with an optional glass cover.
18. Designed to separate under an axial 200-lb pull; does not contain shear pins. Connects between pantograph swivel and refueling hose. Required equipment for pantograph direct fueling stations. AE81284U is for 3-in units (standard for USN/USMC direct fueling stations); AE81284T is for 2.5-in units.
19. Designed to separate under an angular (other than straight or axial) 200-lb pull (up to 45° either side of the axial direction); contains shear pins. For use with refueling trucks. Required equipment for refueling trucks engaged in hot refueling operations (ref [paragraph 11.3.2](#)).





APPENDIX E

Shipboard Hot Refueling Procedures in Support of Special Operations Missions

E.1 PURPOSE

Some Special Operations Forces (SOF) missions require that SOF helicopters when aboard U.S. Navy ships be gravity (overwing) hot refueled. As referred to in [Chapter 6](#), this Appendix has been prepared to assist staff planners, ship operators and SOF personnel in preparing for and conducting overwing hot refueling evolutions when required aboard U.S. Navy aviation and air-capable ships. In the event that a request for overwing hot refueling of SOF helicopters is received, the following shall be strictly adhered to.

Hot refueling any aircraft is inherently dangerous. Overwing hot refueling increases the risk of danger. Hot refueling shall only be conducted with JP-5 fuel.

This appendix shall only apply to ships capable of supporting Special Operations Forces (SOF) during operations where overwing hot refueling of SOF helicopters is required for successful accomplishment of the mission.

E.2 INTRODUCTION

In support of specific SOF mission sets, it is a requirement for U.S. Navy ships to embark SOF helicopters which must be over wing refueled. When helicopter engines are shut down, overwing refueling is not an issue and can be accomplished IAW [paragraph 6.2.4](#). However, certain special operations require that SOF helicopters be hot refueled. This “hot refuel” operation is accomplished IAW SOF helicopter SOPs utilizing a Zodiac Bag (Z-Bag) or overwing refueling.

For the safety of the ship’s crew and the ship involved, familiarity with SOF helicopter refueling procedures should be understood at the highest level possible. When the need arises, the ship shall ensure a safe environment for hot overwing refueling operations. Upon notification that an overwing hot refueling evolution will occur, all personnel involved shall become thoroughly familiar with the evolution through training and indoctrination.

WARNING

Overwing hot refueling increases the risk of fuel spills and ignition of fuel vapors by static electricity and other heat sources.

E.3 RESPONSIBILITIES

This appendix provides standard operating and safety procedures for U.S. Navy ships capable of supporting SOF helicopter operations. The end state is to mitigate risks to an acceptable level for the successful completion of the mission. The steps contained in this appendix are designed to mitigate risks to an acceptable level for the successful accomplishment of the mission. This appendix provides baseline guidance and tactics, techniques, and procedures (TTPs) to assist staff planners, ship operators, and SOF personnel in preparing for and conducting hot overwing refueling operations. In addition,

1. The Commanding Officer is overall responsible for the safe operation of their ship, to include helicopter refueling in support of SOF operations. All considerations to safety should be taken into account.
2. Each ship shall create its own SOP by tailoring this guidance to suit individual unit capabilities and to include more detailed or specific operating procedures if required to ensure a safe and efficient environment.





3. All flight deck personnel will be briefed and aware of hazards associated with conducting hot overwing refueling operations. Personnel shall conduct all tasks in a manner to avoid fuel spill and static electricity discharge during overwing hot refueling operations.
4. Full details on all naval shipboard firefighting apparatus, together with procedures for their use, are given in NSTM Chapter 555 Volume 1, Surface Ship Firefighting. Personnel shall be required to carefully study the information given in NSTM Chapter 555, and shall be thoroughly indoctrinated in the proper procedures and safety precautions for the firefighting systems of their specific ship.
5. Fueling requirements for SOF operations should be coordinated as early as possible; however, due to the time-sensitive nature of some operations, no notice arrival of a SOF unit may occur.
6. Hot overwing refueling observations and lessons learned shall be collected and coordinated with SOF personnel.

E.4 HOT REFUELING REQUIREMENTS

Hot overwing refueling utilizing Z-Bags or overwing nozzles are permitted only during SOF support IAW approved SOF aviation TTPs.

E.5 HOT REFUELING WITH ZODIAC BAGS

E.5.1 Equipment and Manpower Requirements

E.5.1.1 Equipment

1. Z-Bag:
 - a. Volume — Approximately 18 gallons of fuel.
 - b. Empty weight — 10 lbs.
 - c. Maximum capacity — 137 lbs/127 lbs usable fuel.
 - d. Normal capacity — 125 lbs/115 lbs usable fuel.

WARNING

Z-bags used for this refueling procedure shall be a maximum of 25 gallons of JP-5, to limit the maximum possible fuel spill amount.

2. Flight deck fire-fighting equipment will be on-scene during hot overwing refueling operations.
3. P-25 with engine running and staged at a location with a clear view of and response path to the hot refueling area.

Note

Two charge AFFF hoses manned IAW NAVAIR 00-80R-14 may be used in lieu of the P-25 on air-capable ships which do not have P-25s.

E.5.1.2 Manpower

Only the minimum number of personnel including SOF and ship's personnel will be on the flight deck during SOF hot overwing refueling operations.

Note

Only SOF aviation-assigned personnel will conduct overwing refueling operations at the aircraft.





E.5.2 Factors to Mitigate Hot Overwing Refueling Risks with Z-Bags

The following guidance shall be complied with to reduce potential hazards during Zodiac bag refueling.

1. Z-bags should be filled at least 50 feet from aircraft and on the deck. If the Z-Bags are filled inside, such as inside the hangar bay (air capable) or hangar deck (CVN), a separate fire watch with manned extinguisher shall be in the immediate vicinity.

Note

Only PQS certified ship personnel will fill the Z-bags with JP-5 using the ship's refuel hose with over wing nozzle attached.

2. Non-conducting refueling hose shall be used to transfer fuel from the Z-Bag into the aircraft to prevent arcing from metal to metal contact at the aircraft refueling port.
3. Refueling rates less than ~10 gpm shall be used when transferring fuel from the Z-Bag into the aircraft to prevent a static charge accumulation in the fuel (i.e., no mechanical or electrical pumps shall be used to increase the flow rate).
4. The Z-Bag refueling hose shall be inserted fully into refueling port before beginning refueling.
5. Refueling aircraft shall only be performed by SOF personnel specifically trained in these procedures.
6. Z-Bags shall not be dragged from the storage area; deck fittings and non-skid decking have the potential to puncture and tear the Z-Bag.
7. Shipboard procedures shall be followed for spill cleanup.
8. Z-bags shall be stored with caps on tightly to prevent unwanted contaminants in the fuel.

E.5.3 Hot Overwing Z-Bag Refueling Procedures

Note

For single pilot operations or when both crew members must leave the aircraft, the pedals must be locked in a neutral position. See CNO/USSOCOM memorandum of agreement, dated 1997 for the approved procedure.

Z-Bag operations will be performed only by SOF aviation-assigned personnel IAW the following sequence:

1. Place the Z-Bag on the pod length-wise and parallel to the aircraft, with the valve handle facing aft. (See [Figure E-1](#))
2. Move the Z-Bag close to the refuel port and rotate the hose 90 degrees toward the aircraft fuel port. (See [Figure E-4](#))
3. Attach the grounding wire to the deck or ship's structure, then to the aircraft being filled.

WARNING

Proper grounding at the site is necessary to prevent the potential of fire from static electricity.

4. Attach a grounding wire from the Z-Bag D-ring to the aircraft.
5. Remove the cap at the end of the hose and insert the hose into the aircraft fuel port. (See [Figure E-2](#))
6. Rotate the valve handle on the Z-Bag clockwise to start the flow of fuel. (See [Figure E-2](#))



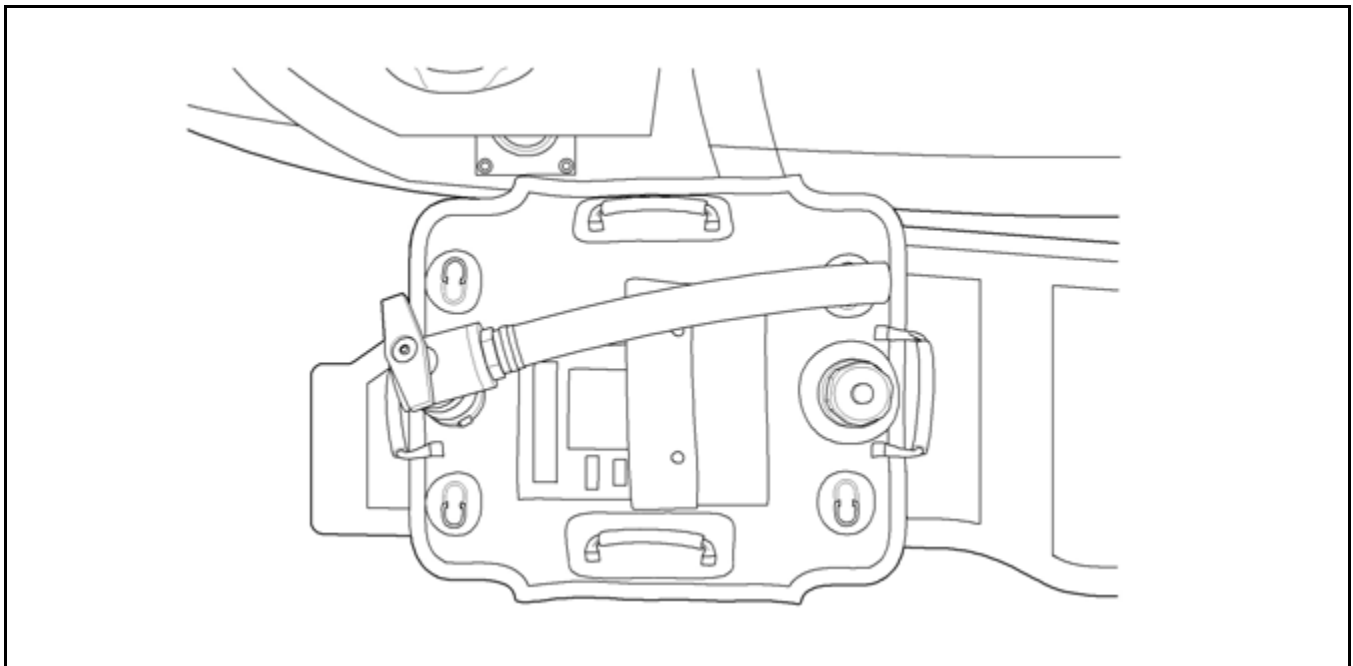
**Note**

- Pushing on the Z-bag helps to force the fuel out faster and reduces time.
- When the bag is about one third full, lift it up to allow remaining fuel to drain into the tank. (See [Figure E-3](#))

7. When the refueling evolution is complete, remove the hose from the aircraft fuel port and replace cap.
8. Remove grounding wire from the Z-Bag D-ring to the aircraft.
9. Remove the grounding wire from the aircraft, then from the deck or ship's structure.
10. SOF support personnel shall exit safely from the aircraft refueling area.

[Figures E-2](#) through [E-3](#) illustrate Z-bag refueling procedures.

Figure E-1. Initial Arrangement of Z-Bag For Overwing Hot Refueling

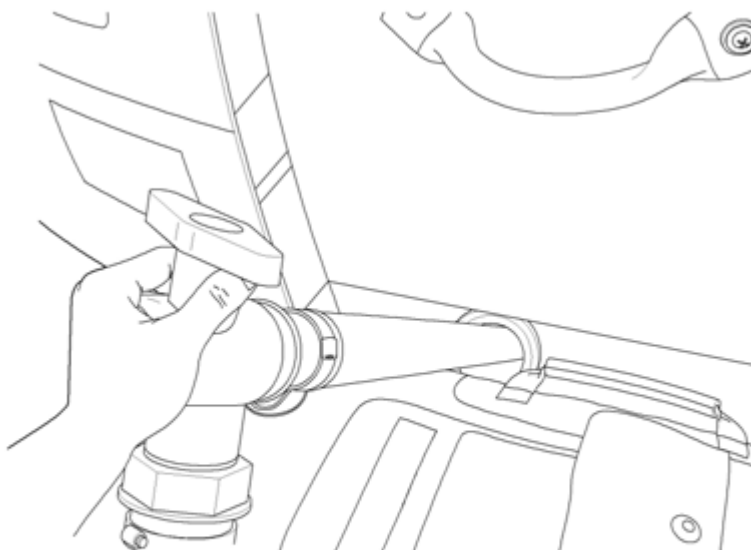
**Note**

The Z-bag is placed on the pod length wise and parallel to the aircraft, with the valve handle facing aft. Rotate the hose 90 degrees toward the aircraft fuel port.





Figure E-2. Z-Bag Refueling in Progress

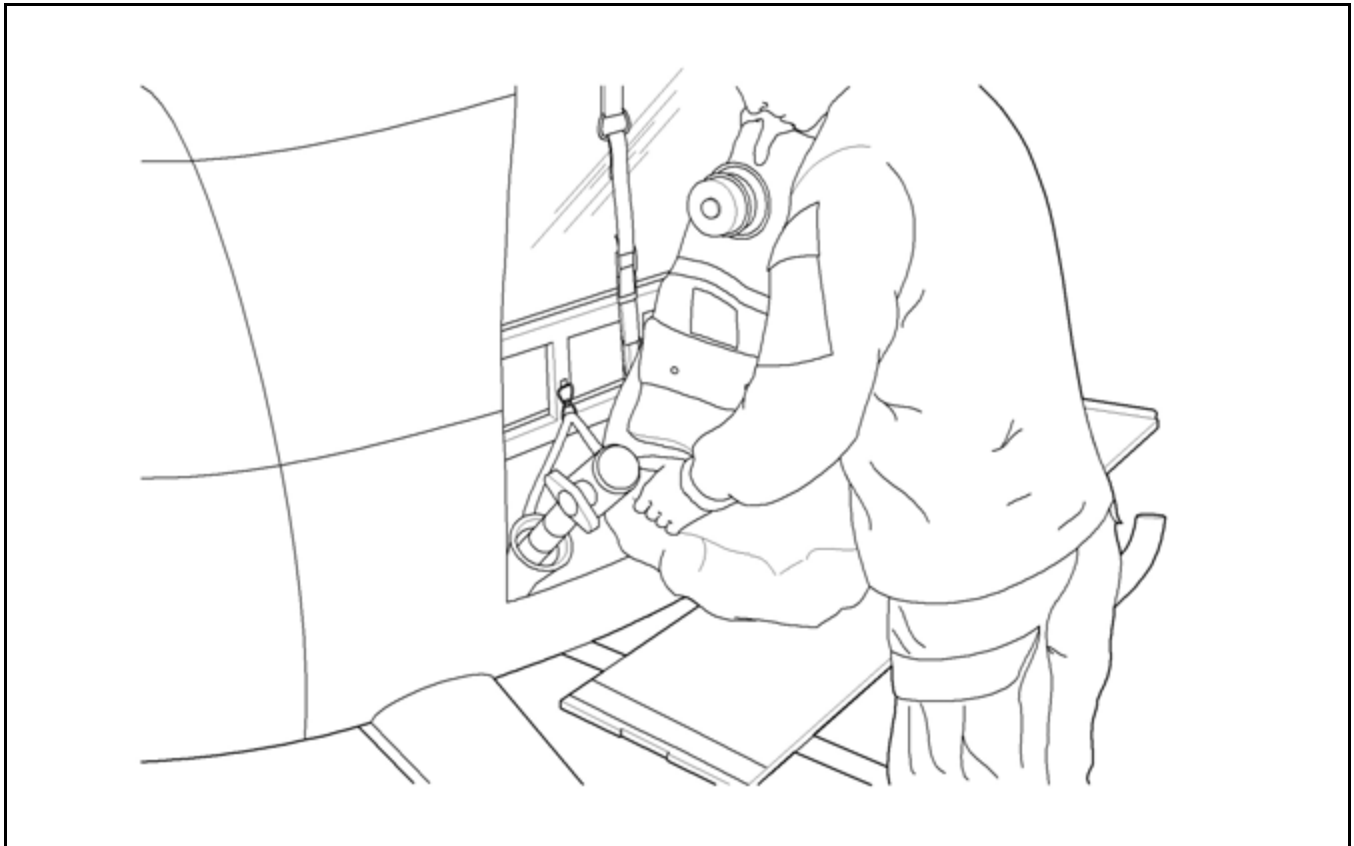
**Note**

The cap is removed from the Z-bag hose and the hose is placed into the refuel port. Rotate the valve handle clockwise to open to allow fuel flow.





Figure E-3. Z-Bag Being Lifted To Permit Fuel To Drain Into Tank



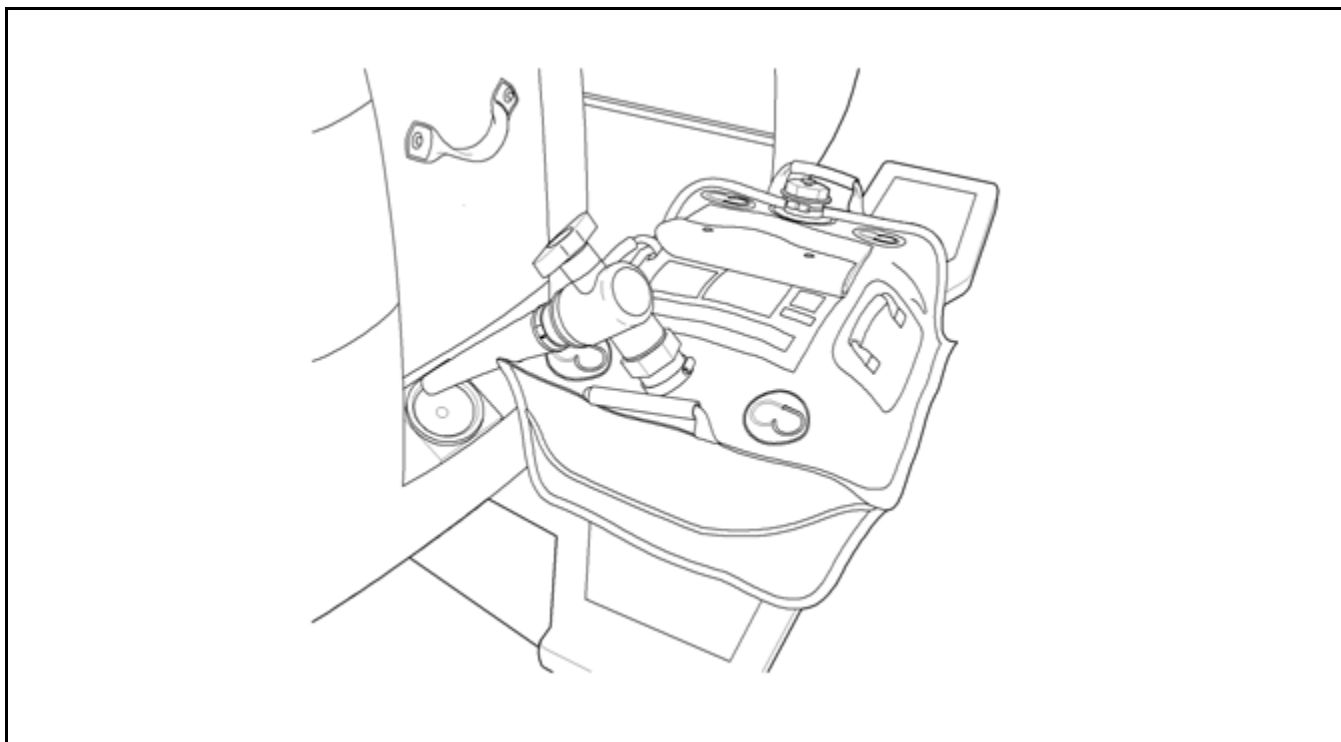
Note

Z-bag nearly empty (approx. 1/3 way full) and being lifted to permit remainder of the fuel to drain.





Figure E-4. Z-Bag Hose Rotated Toward Aircraft Fuel Port



E.6 HOT OVERWING REFUELING

Hot overwing refueling is accomplished using the procedures in [paragraphs 6.2.4](#) and [6.2.5](#) with the following exceptions:

1. Hot refueling may be performed using the overwing nozzle.

Note

Only SOF aviation-assigned personnel will conduct overwing refueling operations at the aircraft.

2. Crew changes are authorized.

Note

When crewmembers must leave the aircraft, the pedals must be locked in a neutral position. See CNO/USSOCOM memorandum of agreement, dated 1997 for the approved procedure.





INDEX

	<i>Page No.</i>		<i>Page No.</i>
A			
AIRCRAFT DEFUELING EQUIPMENT	11-12, 17-7	Use of Plane-to-Plane Transfer Cart to Transfer Low Flashpoint Fuels Between Aircraft	6-23
AIRCRAFT FUELING SYSTEMS	11-5	Appearance (Visual Test)	3-8, 9-10, 15-9
AIRCRAFT REFUELER TRUCK FILL STANDS	11-13	Auxiliary Power Unit: REFUELING AIRCRAFT WITH Auxiliary Power Unit (APU) IN OPERATION	18-22
AIRCRAFT REFUELING EQUIPMENT CHECKLISTS	19-1	Refueling Aircraft with Auxiliary Power Unit (APU) Running	6-11, 18-38
AIRCRAFT REFUELING NATOPS PROGRAM MANAGEMENT ASSIGNMENTS	1-2	AVIATION FUEL QUALITY SURVEILLANCE PROGRAM	9-1, 15-1
Aircraft:		AVIATION FUELS SECURITY WATCH	4-5
Aircraft Direct Fueling Systems	11-5		
Aircraft Entry and Procedures	18-40	B	
Aircraft Entry Procedures	18-46	Barge or Tanker Receipt of Product	12-39
Aircraft Exiting Procedure	18-45, 18-51	Basic Function	4-5
Aircraft Low Point Drain Samples	9-12	Bulk Transfer Line Receipt of Product	18-27
Aircraft Pressure Refueling with Engines Off (Cold Refueling)	6-2		
Aircraft Pressure Refueling with Engines Operating (Hot Refueling)	6-8	C	
Aircraft Refueling Equipment Checklists	13-2	Calibration	13-15
Aircraft Refueling Nozzles†	11-5, 17-3	CHANGE OF PRODUCT IN AIRCRAFT REFUELERS	12-41
Change of Product in Aircraft Defuelers	18-29	Change of Product in Storage Tanks	18-29
Cold Refueling Aircraft with Mobile Refuelers	18-10	CHANGE OF PRODUCT IN STORAGE TANKS	12-41
Cold Refueling Aircraft with Trucks	12-12	CHANGE RECOMMENDATIONS AND QUESTIONS ABOUT AFLOAT SYSTEMS AND PROCEDURES	1-3
Concurrent On-Loading/Off-Loading and Refueling of Aircraft	6-11	Checklist:	
Defueling Aircraft	6-16	Daily Checklist	13-2, 19-1
Disposition of Nonsuspect Fuel Removed from Aircraft	12-37, 18-26	Monthly Checklist	13-11, 19-1
Disposition of Suspect Fuel Removed from Any Aircraft	12-38, 18-26	Storage and Distribution Facilities Checklist	13-14
Duties of Personnel Refueling Aircraft	14-2	The Weekly Checklist	13-9
Fuel Dispensed to Aircraft by Ships	3-2	Weekly Checklist	19-1
Fuel Issued to Aircraft	9-4, 15-3	Checklists:	
Fuel Received by Ships that Fuel Aircraft	3-1	Aircraft Refueling Equipment Checklists	13-2
Handling of Aircraft Containing Fuel Other Than JP-5	6-22	Commanding Officers	1-3
Hanging of Aircraft Containing Fuel Other Than JP-5	6-22	COMMON REFUELING EQUIPMENT/COMPONENTS	17-2
Hot Refueling of USMC Aircraft Loaded With Decoy Flares	12-26	Communication Procedures	18-30
Mobile Aircraft Refuelers	11-9	CONCURRENT ON-LOADING/OFF-LOADING AND REFUELING OF AIRCRAFT	12-33, 18-22
Mobile Aircraft Refuelers (MK970)	17-6	Condition of Truck Parking Areas	11-14, 17-9
Refueling Aircraft with Auxiliary Power Unit (APU) Running	6-11, 18-38	CONFINED SPACES	4-5, 10-4, 16-5
Support of Aircraft Inflight Refueling Probe Maintenance	6-27	Conflicts With This Manual	1-4
		CONTINUING REVIEW OF PRACTICES	1-4
		D	
		Defuelers	11-12, 17-7





Page
No.

Page
No.

DEFUELING AIRCRAFT	12-33, 18-23
Defueling Procedures	12-36, 18-25
Defueling with a Portable Defuel Cart	6-20
Defueling with Installed Station Defuel Pump	6-19
Defueling with Overwing Nozzle	6-21
Density Measurement Equipment	15-8
Disposition of Aviation Gasoline	12-39, 18-27
Disposition of Aviation Turbine Fuels	12-39, 18-27
Distribution Lists for Reports	3-11, 9-13, 15-13
Dry Break Quick Disconnect Coupling†	11-4
Duties	8-2
Duties, Responsibilities, and Authority	4-6

E

Electrical Equipment	11-2
Eliminating Other Sources of Ignition	4-3, 10-2, 16-2
ELIMINATING SOURCES OF IGNITION	4-2, 10-1, 16-1
Emergency:	
Emergency Dry Breakaway Coupling†	11-4
Equipment	E-2
Equipment and Manpower Requirements	E-2
Equipment Requirements	12-23, 18-16, 18-29
EXTINGUISHING FIRES	4-4, 10-3, 16-4

F

Fabric Drums or 55-Gallon Metal Drums Receipt of Product	18-28
Filter/Separator — Pressure Log and Graph	13-14
Filter/Separator Element Change	13-14
Filter/Separators	11-3, 17-2
Filtration Requirements	5-1, 11-1, 17-1
Flash Point Test Equipment	15-9
Flight Clearance Product Set	1-1
FLIGHT CLEARANCE PRODUCTS	1-1
Flight Deck Uniforms	4-4
FORWARD ARMING AND REFUELING POINT (FARP) PROCEDURES	18-29
Free Water	3-8, 9-10, 15-10
Free Water Detection Equipment	15-8
FSII	3-9, 9-11, 15-10
FSII Measurement Kit	15-8
FUEL DIVISION SPACES	11-16
FUEL LABORATORY, TEST EQUIPMENT, AND METHODS	3-6, 9-8
FUEL TESTING STATION, TEST EQUIPMENT, AND METHODS	15-7
Fuel:	
Aviation Fuel Settling	12-41

Disposition of Fuel that Does Not Meet the Allowable Deterioration Limits	12-39, 18-27
Disposition of Nonsuspect Fuel Removed from Aircraft	12-37, 18-26
Disposition of Suspect Fuel Removed from Any Aircraft	12-38, 18-26
Fuel Crew Ready/Training Room	11-16
Fuel Dispensed to Aircraft by Ships	3-2
Fuel Division Laboratory	11-16
Fuel Division Storeroom	11-16
Fuel in Collapsible Storage Tanks	15-3
Fuel in Storage Tanks at Shore Stations	9-3
Fuel Issued to Aircraft	9-4, 15-3
Fuel Maintenance/Management Officers (FMO)	1-3
Fuel Meters	11-4, 17-3
Fuel Office	11-16
Fuel Pressure Gauges	11-4
Fuel Receipts	9-2, 15-1
Fuel Received by Barge or Tanker at Shore Stations	9-3
Fuel Received by Bulk Transfer Line (e.g., AAFS)	15-2
Fuel Received by Collapsible Fabric Drums or 55-Gallon Metal Drums	15-3
Fuel Received by Pipeline at Shore Stations	9-3
Fuel Received by Ships that Fuel Aircraft	3-1
Fuel Received by Tank Car or Tank Truck	15-2
Fuel Received by Tank Car or Tank Truck at Shore Stations	9-2
Fuel Testing Laboratory	5-3
Fuel Testing Station	15-7
Fuel Workshop	11-16
Handling NATO F-37 (JP-8+100) and F-27 (F-24+100) Fuel	6-26
Handling NATO F-37 (JP-8+100)/F-27 (F-24+100) Fuel	12-38, 18-26
Handling of Aircraft Containing Fuel Other Than JP-5	6-22
Hangaring of Aircraft Containing Fuel Other Than JP-5	6-22
Tactical Airfield Fuel Dispensing System (TAFDS)	17-4
FUELING WITH ENGINES OPERATING (HOT REFUELING)	12-23, 18-16
Fueling:	
Aircraft Direct Fueling Systems	11-5
Fueling Helicopters with Engines Not Operating (Cold Refueling)	18-31
Fueling with Engines Operating (Hot Refueling)	18-38



Page
No.Page
No.

Navy Advanced Base Functional Components	
Fueling Systems (ABFC-H14K).....	17-6
Portable Fueling Systems.....	11-11
Fuels Watch.....	4-5

G

General Design and Repair Requirements.....	11-1
GENERAL OPERATING PROCEDURES.....	12-1, 18-1
GENERAL REQUIREMENTS.....	3-1, 5-1, 9-1, 11-1, 13-1, 15-1, 17-1, 19-1
General Rules.....	3-3, 9-6, 15-5
GUIDELINES FOR REQUESTING LABORATORY SERVICES.....	15-12
GUIDELINES FOR REQUESTING REGIONAL LABORATORY SERVICES.....	3-10, 9-12

H

Hangar Deck Uniforms.....	4-5
Hose End Pressure Regulator†.....	11-4, 17-3
Hose End Pressure Regulator (HEPR).....	5-1
Hoses.....	11-4
Hoses and Couplings.....	17-3
HOT REFUELING REQUIREMENTS.....	E-2
HOT REFUELING WITH ZODIAC BAGS.....	E-2

I

Identification of Sample.....	3-4, 9-7, 15-6
Illumination.....	11-2
In-Flight:	
Helicopter In-Flight Refueling (HIFR) Procedures.....	6-9
Helicopter In-Flight Refueling Equipment.....	5-2
Inspections Prior to Use.....	13-2
INTERPRETATION OF TEST RESULTS.....	3-7, 9-9, 15-9
INTRODUCTION.....	4-1, 6-1, 10-1, 12-1, 16-1, 18-1, E-1

L

Laboratory.....	3-6, 9-8
Large Spills.....	12-2, 18-2
Limits:	
Disposition of Fuel that Does Not Meet the Allowable Deterioration Limits.....	12-39, 18-27
LOCAL INSTRUCTIONS.....	1-4
Log Books.....	6-2

M

Manpower.....	E-2
Message Reports.....	3-12, 9-14, 15-13

MINIMIZING HEALTH HAZARDS.....	4-4, 10-4, 16-4
MISCELLANEOUS FUEL DIVISION SAFETY EQUIPMENT.....	11-17
MISCELLANEOUS SAFETY PROCEDURES.....	4-3
Mobile Refueler Marking.....	17-1
MULTIPLE SOURCE REFUELING.....	12-31, 18-21

N

NATO High Capacity (NHC) HIFR.....	5-2
NATOPS Advisory Group.....	1-2
NATOPS Cognizant Command.....	1-3
NATOPS Model Manager.....	1-2
NATOPS Product Set.....	1-1
Night Vision Goggles.....	12-3
Nozzle Flushing Connection.....	5-1

O

Oil:	
Navy Oil Discharge Response.....	12-2
Operation:	
Operation of the JP-5 System.....	6-1
Operations:	
Hot Refueling Operations In Support of Special Operations (Helicopters).....	18-51
Ordnance Procedures.....	18-32, 18-40, 18-48
ORGANIZATION.....	2-1, 8-1, 14-1
ORGANIZATION OF THIS PUBLICATION.....	1-1
OTHER RELATED PUBLICATIONS.....	1-5
Other Test Results.....	3-9, 9-11
Other Tests Results.....	15-11
Overwing/Open-Port (Gravity Refueling).....	18-6

P

Parking Area Requirements.....	17-9
Periodic Inspection and Annual Record.....	19-1
Personnel Requirements.....	12-3, 12-9, 12-11, 12-23, 12-36, 18-3, 18-6, 18-8, 18-16, 18-24, 18-29
PIGGYBACK REFUELING.....	12-32
Pipeline Receipt of Product.....	12-40
PORTABLE CLIMATE SHELTERS.....	11-11
Positioning of Refueler.....	12-14, 18-10
Power:	
REFUELING AIRCRAFT WITH Auxiliary Power Unit (APU) IN OPERATION.....	18-22
Refueling Aircraft with Auxiliary Power Unit (APU) Running.....	6-11, 18-38
PREVENTIVE MAINTENANCE PROGRAM (INSPECTIONS).....	13-1
Priming Spills.....	12-2, 18-2
Procedures.....	12-5, 12-9, 12-12, 18-3, 18-6, 18-8





Page
No.

Page
No.

PROCEDURES FOR PREVENTING AND CONTROLLING CONTAMINATION.....	3-12, 9-14, 15-13
PRODUCT RECEIPT.....	12-39, 18-27
PURPOSE.....	1-1, E-1

R

RECEIVING SITES	17-9
RECEIVING STATIONS	11-14
Record Retention	13-15
RECORDS AND REPORTS	13-15
Reducing Electrostatic Charges	4-2, 10-1, 16-1
REDUCING OR CONTROLLING VAPOR GENERATION	4-3, 10-3, 16-3
Refueler Parking	12-23, 18-16
Refueler Preparation	18-11
Refuelers/Defuelers.....	11-12, 17-7
REFUELING AIRCRAFT AT DIRECT FUELING STATIONS WITH ENGINES OFF (COLD REFUELING).....	12-3
REFUELING AIRCRAFT AT STATIONARY SYSTEMS (TAFDS AND HERS) WITH ENGINES OFF (COLD REFUELING)	18-3
REFUELING AIRCRAFT WITH AUXILIARY POWER UNIT (APU) RUNNING.....	12-32
REFUELING EQUIPMENT	11-2
Refueling:	
Aircraft Pressure Refueling with Engines Off (Cold Refueling)	6-2
Aircraft Pressure Refueling with Engines Operating (Hot Refueling)	6-8
Aircraft Refueling Equipment Checklists	13-2
Aircraft Refueling Nozzles†	11-5, 17-3
Assault Rotary Wing FARP Hot Refueling Sequence of Events.....	18-38
Attack/Utility FARP Hot Refueling Sequence of Events.....	18-45
Cold Refueling Aircraft with Mobile Refuelers	18-10
Cold Refueling Aircraft with Trucks	12-12
Concurrent On-Loading/Off-Loading and Refueling of Aircraft.....	6-11
Duties of Personnel Refueling Aircraft.....	14-2
Factors to Mitigate Hot Overwing Refueling Risks with Z-Bags.....	E-3
FARP Cold Refueling Sequence of Events....	18-31
Filling Mobile Refueling Equipment (e.g., Rigid Tanks).....	18-8
Helicopter Expedient Refueling System (HERS).....	17-4

Helicopter In-Flight Refueling (HIFR) Procedures.....	6-9
Helicopter In-Flight Refueling Equipment	5-2
Hot Overwing Refueling.....	E-7
Hot Overwing Z-Bag Refueling Procedures.....	E-3
Hot Refueling of USMC Aircraft Loaded With Decoy Flares	12-26
Hot Refueling Operations In Support of Special Operations (Helicopters).....	18-51
Hot Refueling Procedures.....	12-25, 18-17, 18-43, 18-48
Hot Refueling Procedures in the Refueling Area.....	12-27, 18-18
Initial Cold Refueling Procedures.....	18-31
Initial Hot Refueling Procedures	18-39, 18-46
Initial Hot Refueling Procedures Prior to Entering the Refueling Area.....	12-25, 18-17
Maximum Refueling Pressure.....	5-1, 11-1, 17-1
Mobile Refueler (MK970/SIXCON) Cold Refueling Procedures.....	18-34
On-Deck Refueling Systems.....	5-2
Overwing (Gravity) Refueling.....	12-9
Overwing Refueling.....	6-5
Overwing/Open-Port Refueling.....	18-14
Precertification Refueling.....	6-26
Pressure Refueling	12-3, 18-3, 18-11
Pressure Refueling Nozzles	5-1
Refueling Aircraft with Auxiliary Power Unit (APU) Running.....	6-11, 18-38
Refueling Equipment Markings and Painting...	11-2
Refueling Vehicle Operator Certification	8-4, 14-2
Refueling Vehicle Parking Area Requirements	11-14
Shipboard Refueling Procedures for Commercial Contract Helicopters	6-27
Stationary System (HERS) Cold Refueling Procedures.....	18-34
Support of Aircraft Inflight Refueling Probe Maintenance.....	6-27
Truck Overwing Refueling	12-21
Truck Pressure Refueling.....	12-17
REGIONAL LABORATORY TEST METHODS AND REPORTING.....	3-10, 9-12, 15-12
Relaxation Chambers	11-4
Relaxation Design.....	17-2
Report Forms	3-11, 9-13, 15-12
Reporting.....	3-10, 9-13, 15-12
Responsibilities.....	8-1, 14-1
RESPONSIBILITIES	1-3, 13-1, E-1
Routine Correlation Sample.....	3-5, 9-7



Page
No.Page
No.

Routine Correlation Samples	3-10, 9-12
Routine Correlation Samples and Tests	3-2
Routine Correlation Sampling and Testing	9-5
Routine Samples	3-10, 9-12, 15-12
Routine Verification Sample	15-6
Routine Verification Samples	15-11
Routine Verification Sampling and Testing	15-4

S

Sample Classification	3-5, 9-7, 15-6
Sample Containers	3-4, 9-6, 15-5
Sampling Connections†	11-4
SAMPLING PROCEDURES	3-3, 9-5, 15-4
SCOPE	1-1
Seasonal or Special Inspections	13-2
Sediment/Particulate Testing Equipment	15-7
Sediment/Particulates	3-8, 9-10, 15-9
SHIPBOARD AIRCRAFT REFUELING PROCEDURES	6-1
SHIPBOARD AIRCRAFT REFUELING SYSTEMS	5-2
SHIPBOARD AVIATION FUEL QUALITY SURVEILLANCE PROGRAM	3-1
Shipping Instructions	3-5, 9-7, 15-7
SHORE STATION REFUELING PROCEDURES FOR COMMERCIAL CONTRACT HELICOPTERS	12-39
Small Spills	12-2, 18-2
Special Sample	3-5, 9-7, 15-6
Special Samples	3-10, 9-13, 15-12
SPECIAL SHIPBOARD SAFETY PRECAUTIONS	4-1
Spill Prevention and Control	12-1, 18-1
Spill Response	18-2
STORAGE TANKS	11-14, 17-9
Surge Pressure Control	12-2, 18-2
System:	
Helicopter Expedient Refueling System (HERS)	17-4
Operation of the JP-5 System	6-1
Stationary System (HERS) Cold Refueling Procedures	18-34
Tactical Airfield Fuel Dispensing System (TAFDS)	17-4

Systems:

Aircraft Direct Fueling Systems	11-5
Navy Advanced Base Functional Components Fueling Systems (ABFC-H14K)	17-6
On-Deck Refueling Systems	5-2
Portable Fueling Systems	11-11

T

TACTICAL FUEL SYSTEMS/EQUIPMENT	17-3
Tank Truck/Tank Car Receipt of Product	12-40, 18-28
Test Methods	3-7, 9-9, 15-9
Test Results Action	3-7
Testing Equipment	3-6, 9-8, 15-7
The Periodic Inspection and Annual Record	13-13
TRAINING REQUIREMENTS	2-1, 8-4, 14-2
Training:	
Formal Training	2-1
General Training Requirements	8-4, 14-2
Nozzle Operators' Training and Certification ...	8-4, 14-2
TRANSFER LINES	11-16
TRANSFERRING FUEL FROM ONE AIRCRAFT TO ANOTHER	12-32, 18-22
Truck Fill Stands	12-11
TRUCK OPERATIONS	12-11, 18-8
TRUCK PARKING AREAS	11-14, 17-9
Truck Preparation Procedures	12-17
Two-Point FARP Personnel Requirements	18-29

U

UNIFORMS	4-4
Unisex Couplings	5-2
Users	1-3

W

WAIVERS	1-4
WEAPONS HANDLING PROCEDURES	10-5
Wing:	
Assault Rotary Wing FARP Hot Refueling Sequence of Events	18-38

