TO 00-25-172

TECHNICAL MANUAL

GROUND SERVICING OF AIRCRAFT
AND
STATIC GROUNDING/BONDING

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FOREWORD

1 PURPOSE.

This technical order provides guidance to help minimize injury and property damage mishaps associated with aircraft ground servicing operations and other allied support functions accomplished concurrently with ground servicing. Additionally, this technical order provides information on the nature of, and methods to minimize electrical hazards associated with servicing operations.

2 SCOPE.

This technical order applies to all USAF aircraft ground servicing operations as well as servicing of non-USAF aircraft when performed at USAF or non-USAF installations by USAF personnel, or under USAF control. Excluded is the servicing of air launched missiles and stores. Where procedures in this technical order conflict with Mission/Design/Series (MDS) specific technical order procedures, the MDS specific technical order shall take precedence.

3 ABBREVIATIONS.

All abbreviations used in this manual are in accordance with ASME Y14.38, Abbreviations and Acronyms for Use on Drawings and Related Documents.

ABFDS	Aerial Bulk Fuels Delivery System
ACE	Alternate Capability Equipment
ADI	Anti-Detonation Injection
AF	Air Force
AFFF	Aqueous Film Forming Foam
AFTO	Air Force Technical Order
AMC	Air Mobility Command
APU	Auxiliary Power Unit
ARFF	Aircraft Rescue and Fire Fighting
AWIS	Aircraft Wireless Intercom Systems
BEE	Bioenvironmental Engineer
CASS	Centralized Aircraft Support Systems
CFETP	Career Field Education and Training Plan
CSG	Combat Sortie Generation
CSO	Concurrent Servicing Operation
CSS	Chief Servicing Supervisor
CSS	Concurrent Servicing Supervisor
CU	Conductivity Units
CWDE	Chemical Warfare Defense Ensemble
ECM	Electronic Countermeasures
ECS	Environmental Control System
EPU	Emergency Power Unit
ESS	Emergency Starting System
FAM	Forward Area Manifold
FARE	Forward Area Refueling Equipment
FARP	Forward Area Refueling Point
FOD	Foreign Object Damage
FORCE	Fuels Operational Readiness Capability Equipment
FSAS	Fuel Saving Advisory System
FSII	Fuel System Icing Inhibitors
FSSZ	Fuel Servicing Safety Zone
FTR	Flow Through Revetment
GPM	Gallons Per Minute
GPU	Ground Power Unit
GTC	Gas Turbine Compressor
HAS/PAS	Hardened Aircraft Shelters/Protective Aircraft Shelters
HDPS	Hose Deployment Personnel
HEMTT	Heavy Expanded Mobility Tactical Truck
HF	High Frequency
HHT	Hydrant Hose Trucks
HRS	Hot Refueling Supervisor
HSV	Hydrant Servicing Vehicles
HTARS	HEMTT Tanker Aviation Refueling System
IAFTS	Internal Auxiliary Fuel Tank System
IBA	Individual Body Armor
IFE	In-Flight Emergency
INS	Inertial Navigation System
JFS	Jet Fuel Starters
LEL	Lower Explosive Limit
LFL	Lower Flammable Limit
LIN	Liquid Nitrogen
LOX	Liquid Oxygen
LRU	Line Replaceable Unit
MAF	Mobility Air Fleet
MDS	Mission/Design/Series
MIS	Management Information System
MOC	Maintenance Operation Center
OPR	Office of Primary Responsibility
PACS	Protective Aircraft Canopy Shelters
PPE	Personal Protective Equipment
psi	pound-force per square inch
psig	pounds per square inch gauge
PTO	Power Takeoff
Q-D	Quantity-Distance
REO	Refueling Equipment Operator
RPO	Refueling Panel Operator
SATCOM	Satellite Communications
SCR	Supervisory Contractor Representative
SE	Support Equipment

SFO	Senior Fire Officer
SKE	Station Keeping Equipment
SPR	Single Point Receptacle
SPRM	Single Point Receptacle Monitor
SSEA	System Safety Engineering Analysis
UEL	Upper Explosive Limit
UFL	Upper Flammable Limit

4 RELATED PUBLICATIONS.

The following publications contain information in support of this technical manual.

List of Related Publications

Number	Title
A-A-50022B	Gloves, Welder's, Leather, Gauntlet
A-A-52475A	Chock, Wheel
A-A-55213	Gloves, Permeable, Cloth, Cotton, Olive Green
AFH 32-1084	Facility Requirements
AFI 21-101	Air and Space Equipment Maintenance Management
AFI 23-502	Recoverable and Unusable Liquid Petroleum Products
AFI 91-202	US Air Force Mishap Prevention Program
AFI 91-203	Air Force Consolidated Occupational Safety Instruction
AFMAN 91-201	Explosives Safety Standards
AFOSH STD 48-1	Respiratory Protection Program
AFOSH STD 48-8	Controlling Exposures to Hazardous Materials
API/IP STD 1529	Aviation Fuelling Hose and Hose Assemblies
ASME Y14.38	Abbreviations and Acronyms for Use on Drawings and Related Documents
MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests
MIL-STD-882D	Standard Practice for System Safety
MIL-DTL-6615G	Hose Assemblies, Rubber, Fuel and Nonpotable Water, with Reattachable Couplings, Low Temperature, General Specification for

List of Related Publications - Continued

Number	Title
MIL-DTL-26521K	Hose Assembly, Nonmetallic, Fuel, Collapsible, Low Temperature with Non-Reusable Couplings
MIL-DTL-26894D	Hose and Hose Assembly, Rubber, Gasoline, Refueling, Low Temperature
MIL-DTL-27516F	Hose and Hose Assembly, Nonmetallic, Suction and Discharge
MIL-PRF-370J	Hose and Hose Assemblies, Nonmetallic: Elastomeric, Liquid Fuel
MIL-PRF-32058	Chock, Wheel-Track - Aviation, Adjustable Rope Type
NFPA 10	Standard for Portable Fire Extinguishers
NFPA 70	National Electrical Code
NFPA 407	Standard for Aircraft Fuel Servicing
SAE AS 38404	Couplings, Hose, Reattachable Screw-On
TO 00-5-1	Air Force Technical Order System
TO 00-25-234	General Shop Practice Requirements for the Repair, Maintenance, and Test of Electrical Equipment
TO 1-1-3	Inspection and Repair of Aircraft Integral Tanks and Fuel Cells
TO 11A-1-33	Handling and Maintenance of Explosives Loaded Aircraft
TO 13F4-4-121	Operation, Service and Maintenance with Illustrated Parts Breakdown Fire Extinguisher, Wheeled Liquified Gas, 150 lb. Capacity Part No. 03496 and 05673
TO 14P3-11-1	Protective Clothing for Handlers of Missile Fuels and Oxidizers
TO 15X-1-1	Maintenance Instructions - Oxygen Equipment
TO 31Z-10-4	Electromagnetic Radiation Hazards

List of Related Publications - Continued

Number	Title
TO 37C2-4-6-13	Overhaul Instructions with Illustrated Parts Breakdown Liquid Oxygen Filler Valve Type CRU-59/E PN 20C-0021-2 NSN 4820-00-796-9680YD
TO 37C2-4-6-21	Operation, Maintenance with Illustrated Parts Breakdown Liquid Oxygen Filler Valve CRU-59/E Part Number LV1363
TO 35E10-19-1	MISSING TITLE
TO 35E10-22-1	Operation and Maintenance Instructions Liquid Cooling System Cooler MXU-659A/E Part Number ACE-410-922 Winterization Kit Part Number 84094 Rev B
TO 36A12-13-31-1CL-1	Checklist Aircraft Servicing Procedures with the Hydrant Servicing Vehicle (HSV)
TO 36A12-13-1-131CL-1	MISSING TITLE
TO 37A2-2-4-1CL-1	Operational and Organizational Maintenance Refuel/Defuel Procedures All MH-2 Series Filter-Meter-Hose Fuel Transfer Trailer and KC-135 Rapid Defuel E-4B Hot Refueling

List of Related Publications - Continued

Number	Title
TO 37A9-3-11-1CL-1	Checklist Operational and Organizational Maintenance Hot Refueling and Hot Integrated Combat Turnaround Procedures Aircraft Fuel Servicing Unit Type GRU 17/E Pantograph PACAF Type IV Hydrant Servicing
TO 42B-1-23	Management of Recoverable and Waste Liquid Petroleum Products
TO 42B2-1-3	Management of Recoverable and Waste Liquid Petroleum Products
TO 42B5-1-2	Use, Handling and Maintenance Instructions - Storage Type Gas Cylinders
TO 42B6-1-1	Quality Control Aviators Breathing Oxygen and Aviators Gaseous Breathing Oxygen
TO 42B7-3-1-1	Quality Control of Nitrogen
TO 42C-1-16	Use and Quality Control of Demineralized Water and Water-Alcohol Mixtures for Aircraft Engines

5 RECORD OF APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS (TCTOS).

List of Time Compliance Technical Orders

TCTO Number	TCTO Title	TCTO Date
TCTO 1388	MIL-STD-1388-2B has been replaced with MIL-PRF-49506 PERFORMANCE SPECIFICATION LOGISTICS MANAGEMENT INFORMATION.	

6 CHANGE RECOMMENDATIONS.

Recommendations concerning changes to this manual shall be submitted in accordance with TO 00-5-1.

SAFETY SUMMARY

1 GENERAL SAFETY INSTRUCTIONS.

This manual describes physical and/or chemical processes which may cause injury or death to personnel, or damage to equipment, if not properly followed. This safety summary includes general safety precautions and instructions that must be understood and applied during operation and maintenance to ensure personnel safety and protection of equipment. Prior to performing any specific task, the WARNINGs, CAUTIONs, and NOTEs included in that task shall be reviewed and understood.

2 WARNINGS, CAUTIONS, AND NOTES.

WARNINGs and CAUTIONs are used in this manual to highlight operating or maintenance procedures, practices, conditions, or statements which are considered essential to protection of personnel (WARNING) or equipment (CAUTION). WARNINGs and CAUTIONs immediately precede the step or procedure to which they apply. WARNINGs and CAUTIONs consist of four parts: heading (WARNING, CAUTION, or icon), a statement of the hazard, minimum precautions, and possible results if disregarded. NOTEs are used in this manual to highlight operating or maintenance procedures, practices, conditions, or statements which are not essential to protection of personnel or equipment. NOTEs may precede or follow the step or procedure, depending upon the information to be highlighted. The headings used and their definitions are as follows:

WARNING

Highlights an essential operating or maintenance procedure, practice, condition, statement, etc., which if not strictly observed, could result in injury to, or death of, personnel or long term health hazards.

CAUTION

Highlights an essential operating or maintenance procedure, practice, condition, statement, etc., which if not strictly observed, could result in damage to, or destruction of, equipment or loss of mission effectiveness.

NOTE

Highlights an essential operating or maintenance procedure, condition, or statement.

3 REPORTING OF HAZARDS.

Any potential hazard shall be reported to supervision. Examples of hazards that should be reported are:

- Glowing or crackling fuel.
- Visible areas or sparks from any source.
- Electrical shocks to personnel.
- Aircraft with defective grounding/bonding receptacles.
- Fluid leaks, mists, or sprays.

4 RECOVERABLE PRODUCTS.

Recoverable products resulting from ground handling and servicing of aircraft will be handled in accordance with federal, state, and local pollution control laws. Refer to AFI 23-502, Recoverable and Unusable Liquid Petroleum Products, and TO 42B-1-23, Management of Recoverable and Waste Liquid Petroleum Products. Fuel or oil spills will be reported to the base fire department and the civil engineering pollution control response team as required by local directives. Implement spill control procedures in accordance with local directives.

5 SYSTEM SAFETY ENGINEERING ANALYSIS (SSEA).

An SSEA is a detailed engineering review of an operation. It includes failure modes and effects analysis, criticality assessments, and hazard analyses as outlined in MIL-STD-882D. These analyses consider the weapon system, the support equipment, and the personnel interfaces. An SSEA is used to establish the degree of risk involved in a new procedure. Any change to the approved hot refueling or concurrent servicing listed in this technical order, or the addition of new procedures, require HQ AFMC/SES approval. Refer to AFI 91-202 or contact HQ AFMC/SES for an explanation of policies, responsibilities, authority, and administrative steps necessary to request an SSEA.

CHAPTER 1
INTRODUCTION

1.1 RESPONSIBILITIES.

Commanders, managers, and supervisors shall ensure that all aircraft servicing personnel under their supervision are knowledgeable of requirements in applicable directives and technical orders, proficient in accomplishing servicing operations and exercise safe practices during ground servicing operations.

1.2 DEFINITIONS.

The following definitions apply in regard to the text of this technical order.

- ***Shall and Will*** - Indicate mandatory requirements. Will is also used to express a declaration of purpose.
- ***Should*** - Indicates a preferred method of accomplishment.
- ***May*** - Indicates an acceptable or suggested means of accomplishment.

1.2.1 Aircraft Fuel Servicing. The movement of fuel to or from an external source to or from an aircraft through a Single Point Refuel (SPR) receptacle, including the time during which fueling connections and disconnections are made (bond wires and nozzles). This also includes checks made to verify fuel quantity and time to clean up or neutralize any spilled fuel.

1.2.2 Aircraft Servicing Supervisor. The person responsible for the aircraft fuel servicing operations. The individual shall be task trained and certified as required by the Career Field Education and Training Plan (CFETP) and any other MAJCOM or local maintenance/training directives.

1.2.3 Bonding. Electrically connecting two or more components of a system to equalize voltage potential.

1.2.4 Cathodic Protection. A means of protecting metals from corrosion by making the metal the cathode of an electrolytic cell. Pipelines, tanks, and steel piers (wharves) are often protected in this manner.

1.2.5 Chief Servicing Supervisor (CSS) (Chapter 5). The person responsible for on-site supervision of all aspects of concurrent fuel servicing operations. The individual shall receive familiarization training on safety requirements and potential hazards of concurrent servicing operations and be certified as required by MAJCOM and local maintenance/training directives.

1.2.6 Concurrent Servicing (Commercial, Contract, Cargo, Passenger Aircraft). The simultaneous servicing of fuel or oxygen with either passengers on board or the performance of minor maintenance, fleet servicing, or baggage or cargo loading/unloading.

1.2.7 Concurrent Servicing Area. The area within an imaginary circle around the aircraft that includes the fuel servicing safety zones and extends at least 10 feet outboard of the aircraft wingtips, tail, and nose.

1.2.8 Concurrent Servicing Operations (CSO) Supporting Combat Sortie Generation (CSG). The simultaneous fueling, and munitions/ammunition loading/unloading, aircraft reconfiguration, aircraft -6 TO inspections, and other aircraft servicing such as oil, nitrogen, and hydraulic fluid. Oxygen servicing will not be accomplished during fuel servicing.

1.2.8.1 CSOs Requiring a Concurrent Servicing Supervisor (CSS). The key function requiring the CSS is refueling/defueling. When no refuel/defuel operations are taking place concurrent with any other maintenance/munitions tasks, a CSS is not required.

1.2.8.1.1 Simultaneous fuel servicing with aircraft -6 and -6WC inspections.

1.2.8.1.2 Simultaneous fuel servicing with munitions/ammunition loading/unloading.

1.2.8.1.3 Simultaneous fuel servicing with aircraft reconfiguration.

1.2.8.1.4 Simultaneous fuel servicing and other aircraft servicing such as oil, nitrogen, and hydraulic fluid.

1.2.8.1.5 Simultaneous fuel servicing with loading/unloading of munitions/ammunition, aircraft reconfiguration, air-

craft -6 TO inspections, and other aircraft servicing such as oil, nitrogen, and hydraulic fluid.

NOTE

Electrical "power-on" portions of -6 inspections are not authorized during concurrent munitions loading/unloading and fuel servicing operations. Power-on portions of -6 inspections are accomplished prior to or upon completion of the concurrent munitions loading/unloading and fuel servicing operation.

1.2.8.2 CSOs Not Requiring a Concurrent Servicing Supervisor (CSS).

1.2.8.2.1 On MAF aircraft, CSO is not required while aircrew members are performing the -1 inspection. See Paragraph 5.1.

1.2.8.2.2 Any or all simultaneous munitions/ammunition loading/unloading with aircraft -6 and -6WC TO inspections, aircraft reconfiguration, and other aircraft servicing such as oil, nitrogen, and hydraulic fluid. (When no refuel/defuel operations are taking place concurrent with any other maintenance/munitions tasks, a CSS is not required).

NOTE

When a CSS is not required the weapons load crew chief is responsible for and controls all actions concerning the aircraft during loading and unloading operations. See AFI 21-101, Chapter 4 for detailed responsibilities.

1.2.9 Concurrent Servicing Supervisor (CSS) Combat Sortie Generation (CSG) (Chapter 6). The on-site supervisor responsible for all aspects of fuel servicing, munitions/ammunition loading/unloading, aircraft reconfiguration, aircraft -6 TO inspections, and other aircraft servicing performed during CSOs. The key function requiring the CSS is refueling/defueling. When no refuel/defuel operations are taking place concurrent with any other maintenance/munitions tasks, a CSS is not required. The individual shall receive training on safety requirements and potential hazards of concurrent servicing operations and be certified as required by AFI 21-101, MAJCOM, and local maintenance/training directives.

1.2.10 Deadman Control. An electrically, hydraulically, mechanically, or pneumatically operated switch or valve requiring continuous positive hand pressure by the operator to maintain fuel flow. Releasing the positive hand pressure stops fuel flow.

1.2.11 Defueling. Defueling is the movement of fuel from an aircraft fuel tank to any external, approved container or system through the SPR receptacle to exclude the draining of small amounts of residual fuel from externally mounted components (i.e., fuel pumps, valves, engines) as authorized per TO 1-1-3, Page 2-8, Paragraph 2.7.9, and removal of fuel or other liquids from cells or tanks via the aircraft fuel system drains.

1.2.12 Flash Point. The lowest temperature at which vapors arising from fuel will ignite (momentarily flash) on application of a flame or spark.

1.2.13 Fuel Servicing Hose.

1.2.13.1 Soft (Collapsible). Rubber hose conforming to MIL-DTL-26521K, flexible, capable of being completely flattened and coiled for ease of storage and handling.

1.2.13.2 Semi-hard (Noncollapsible). Rubber hose conforming to MIL-DTL-6615G and MIL-PRF-370J, braided, loomed, or plied reinforcement, not capable of being coiled easily.

1.2.13.3 Hard (Noncollapsible). Rubber hose conforming to MIL-DTL-27516F and MIL-DTL-26894D, braided, loomed, or plied reinforcement with a steel spiral wire wound between reinforcing members.

1.2.14 Fuel Servicing Safety Zone (FSSZ). The area within 50 feet of a pressurized fuel carrying servicing component, i.e., servicing hose, fuel nozzle, Single Point Receptacle (SPR), hydrant hose cart, ramp hydrant connection point, etc., and 25 feet around aircraft fuel vent outlets.

1.2.15 Fuel Servicing Vehicle. A mobile self-propelled vehicle designed with a power take-off and filter separator to transport, receive, and dispense fuel. The most common type of fuel servicing unit in the Air Force inventory is R-11.

1.2.16 Fuel Spill. Dripping, splashing or overflow of fuel. The fuel spill classifications are:

1.2.16.1 Class I spills involve an area less than two feet in any plane dimension (direction). Using agency fireguards, determine if these spills create a fire hazard to the aircraft or equipment. Generally, these spills need only be monitored until the aircraft is dispatched.

1.2.16.2 Class II spills involve an area not over 10 feet in any plane dimension (direction), or not over 50 square feet and not of a continuing nature. Post the area, using agency fireguards, and immediately notify the fire protection organization and the base agency responsible for cleanup of hazardous spills.

1.2.16.3 Class III spills involve an area over 10 feet in any plane dimension (direction) or over 50 square feet in total area or of a continuing nature. Post the area, using agency fireguards, and immediately notify the fire protection organization and the base agency responsible for cleanup of hazardous spills. These conditions shall be considered a ramp

mishap (accident or incident). The senior fire official will respond with the personnel, vehicle(s) and equipment necessary to control and contain the hazardous condition until the local base agency responsible for cleanup can properly dispose of the hazardous material(s).

1.2.17 Flow Through Revetment (FTR). An open ramp parking area with protective earth filled steel walls several feet thick designed to protect the aircraft.

1.2.18 Grounding (Electrostatic). A path or means to remove any electrostatic charge buildup on a conductive object by connecting that conductive object to earth.

1.2.19 Hose Cart (MH-2 Series). A trailer-mounted unit containing a filter separator, meter, hoses, and nozzles for connecting the hydrant outlet to the aircraft. It may be used with the Type II system or Type I modified system. It may be equipped with a Y-adapter to permit refueling two aircraft at the same time. It may also be used to refuel commercial aircraft requiring simultaneous servicing into both wings.

1.2.20 Hot Pad Refueling Supervisor. A person (five-level or higher) with overall supervisory responsibility for simultaneous hot refueling operations.

1.2.21 Hot Refueling/Defueling. The transfer of fuel into or out of the fuel tanks of an aircraft with one or more aircraft engine operating.

1.2.22 Hot Refueling/Defueling Area. The area within 50 feet of a hot refueling/defueling operation. Refer to Table 3-2 for specific requirements.

1.2.23 Hydrant Hose Truck. A self-propelled aircraft fuel servicing unit capable of dispensing up to 1200 GPM, equipped with inlet and discharge hoses, meter, filter/separator, various pressure and flow control valves, and safety devices. Hydrant Hose Trucks (HHT) are also known as Hydrant Servicing Vehicles (HSV).

1.2.24 Hydrant Operator. A person (AFSC 2F0X1) who activates electrical and/or magnetic switches and valves necessary for fuel to flow from the hydrant system to the aircraft on the Type I, Type II, Type III, and Type IV hydrant systems. Operates hydrant hose truck, hose cart, or pantograph. The Type IV operator is positioned at the control pit, maintains visual contact with all crew members, monitors pressure gauges and the meter in the hydrant pit. In an emergency or upon signal from the aircraft refueling or pad refueling supervisor, they activate the emergency electrical shutdown switch and the fire suppression system.

1.2.25 Hydrant Outlet. A fueling valve located on the parking ramp where the fuel hose or hose cart is connected.

1.2.26 Intrinsically Safe. Equipment and wiring that is not capable of producing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a flammable or combustible atmospheric mixture in its most easily ignitable concentration. This equipment is suitable for use where fuel vapors can exist. Devices meeting the explosive vapor tests of MIL-STD-810 meet the intrinsically safe requirements of the National Fire Code.

1.2.27 Lateral Control Pit. An area below ground level adjacent to the parking ramp containing components of the hydrant system and controlling one or more hydrant outlets.

1.2.28 Lateral Control Pit Switch. An on/off explosion proof switch, usually located at the hydrant control pit.

1.2.29 Lateral Control Pit Emergency Switch. A switch located at the control pit which overrides all other on/off switches and shuts down the entire hydrant system. Type II hydrant systems also have an emergency switch at each outlet.

1.2.30 Liquid Oxygen (LOX) Servicing Safety Zone. The area within 20 feet of pressurized LOX servicing equipment, servicing hose, aircraft servicing connection point or vents.

1.2.31 Pantograph. A fuel servicing system consisting of multiple rigid sections of tubing interconnected by articulating and swivel couplings with fuel flow controlled by a deadman switch.

1.2.32 Mobility Air Fleet (MAF). MAF aircraft are airframes within AMC and those same airframes located outside of AMC (typically overseas units within PACAF, USAFE, AFCENT), with the exception of AFSOC.

1.2.33 Ramp Grounds. Ground rods used on ramps or aprons for protection against stray electrical currents, electrical faults, lightning, and static electricity.

1.2.34 Rapid Defueling. A means to rapidly off load fuel from aircraft either by operating an outboard engine or external hydraulic test stand to power on-board refueling pumps.

1.2.35 Refueling. The movement of fuel from an external source to an aircraft.

1.2.36 Remote Control Fuel Switch. A portable push-button on/off explosion proof switch attached to the hydrant outlet by an insulated, flexible control cable and used to start and stop fuel flow. This may also be a magnetic switch with a lanyard.

1.2.37 Servicing Crew Member. A person who performs duties required by the specific servicing checklist under the supervision of the oxygen, refuel/defuel supervisor, or chief servicing supervisor. For C-9 medical evaluation aircraft only, the Chief Servicing Supervisor (CSS) can also function as the Refueling Panel Operator (RPO) and the Single Point Receptacle Monitor (SPRM). In this case, a person in AFSC 4NOXX or X8AOO can perform duties as a safety observer in front of the C-9 aircraft but must be on intercom with the CSS and the aircrew.

1.2.38 Combat Sortie Generation. Combat sortie generation is a process by which mission capable fighter aircraft are generated in a minimum amount of time, during peacetime or wartime, through separate 2AXXX and 2WXXX tasks or by Concurrent Servicing Operations (CSO). Combat sortie generation may include fueling, munitions/ammunition loading/unloading, aircraft reconfiguration, -6 TO inspections, and other servicing requirements.

1.2.39 Shelters.

1.2.39.1 Aircraft Alert Shelter. A covered unhardened/unprotected structure with or without doors from which a mission ready aircraft can be launched. Aircraft are expected to start engine within the shelter and taxi out of the shelter under their own power. Some shelters are designed to allow the aircraft to taxi in as well. Some shelters provide protection from the elements, others are complete hangars.

1.2.39.2 Hardened Aircraft Shelters (HAS)/Protective Aircraft Shelters (PAS). Refer to Figure 4-1.

1.2.39.2.1 First Generation Shelters. These shelters have two manually operated, vertically hinged, prow-shaped, recessed, metal aircraft entry doors. Usable floor space is 48 feet by 75 feet.

1.2.39.2.2 Modified First Generation Shelters. These shelters have one electrically operated, side opening, roller supported, prow-shaped, externally mounted, metal aircraft entry door. Usable floor space is 48 feet by 100 feet.

1.2.39.2.3 Second Generation Shelters. These shelters have two electrically operated, side opening, roller supported, externally mounted, reinforced concrete panel aircraft entry doors. Usable floor space is 82 feet by 124 feet.

1.2.39.2.4 Third Generation Shelters. Same as second generation except usable floor space is 71 feet by 120 feet.

1.2.39.2.5 Protective Aircraft Canopy Shelters (PACS). These “carport type” shelters have fabric covered canopies designed to protect personnel and aircraft from the elements. They do not have doors or walls.

1.2.40 Supervisory Contractor Representative (SCR). The person responsible for the control of contractor personnel involved in concurrent servicing operations, fuel nozzle connection/disconnection, and operation of refueling control panel on commercial aircraft.

1.2.41 Support Equipment (SE). All equipment required on the ground to make a weapon system, command and control system, subsystem, or end item of equipment operational in its intended environment.

1.2.42 Switch Loading. The introduction of a low volatility fuel such as JP-8 into a tank containing a residue of a higher volatility fuel such as JP-4, and vice versa.

1.2.43 Transferring of Fuel. The movement of fuel within the aircraft internal fuel system. This term also applies to bulk movement of fuel.

1.3 REPORTING OF HAZARDS.

Any potential hazard shall be reported to local supervision. Examples of hazards that should be reported are:

a. Glowing or crackling fuel.

b. Visible areas or sparks from any source.

c. Electrical shocks to personnel.

d. Aircraft with defective grounding/bonding receptacles.

e. Fluid leaks, mists, or sprays.

1.4 RECOVERABLE PRODUCTS.

Recoverable products resulting from ground handling and servicing of aircraft/equipment will be handled in accordance with federal, state, and local environmental directives or laws. Refer to AFI 23-502, Recoverable and Unusable Liquid Petroleum Products, and TO 42B-1-23, Management of Recoverable and Waste Liquid Petroleum Products.

1.5 FUEL OR OIL SPILLS.

Fuel or oil spills will be reported to the base fire department and the civil engineering pollution control response team as required by local directives. Implement spill control procedures in accordance with local directives.

CHAPTER 2
ELECTROSTATIC HAZARDS AND STATIC GROUNDING AND BONDING

2.1 INTRODUCTION.

Fire or explosion hazards are always present where fuels are handled. The grounding or bonding of all conductive parts of the system are an effective means of controlling hazards created by electrostatic energy. Grounding is the process of connecting one or more metallic objects and ground conductors to ground electrodes. Bonding is the process of connecting two or more metallic objects together by means of a conductor. Bonding is done to equalize electrostatic potential between two or more conductive objects.

2.2 ELECTROSTATIC CHARGES.

Static electricity is frequently generated when two materials are brought into contact and then separated. Removing items of clothing, dust blowing across a surface, a liquid flowing through a pipe, and moving vehicles are common means of producing a static charge. Static electricity has been the ignition source for many petroleum fires. Protection against static charge buildup is obtained by dissipating static charges through proper connections to the ground or equalizing static charges through effective bonding.

2.3 STRAY CURRENTS.

Electrical currents flowing through paths other than their intended circuits, or any extraneous current in the earth are stray currents. Since Air Force fixed refueling systems are in contact with the earth, stray currents sometimes take paths through the conducting parts of the system. Grounding or bonding does not eliminate stray currents.

2.4 COMBUSTION.

Combustion requires fuel vapors, air (oxygen), and an ignition source. Flammable vapors exist over the surface of JP-4 at -10 °F and above, and aviation gasoline at -50 °F and above. Ignition of these vapors can be caused either by a spark or flame. When the proper ratio of fuel vapor and air is present, ignition will result in fire or explosion. Energy levels associated with electrostatic discharges may be sufficient to ignite fuel vapors.

2.5 ELECTROSTATIC CHARGING OF PERSONNEL.

The normal activity of personnel involved in refueling operations can generate static electricity charges on their clothing. Humidity greatly affects the static electricity characteristics of clothing materials. The lower the humidity, the higher the electrostatic hazard. Under low humidity conditions, almost all Air Force issued garments can produce a static charge of sufficient potential to cause a discharge. The wearing of multiple garment layers in itself does not cause an excessive static charge to develop. However, never remove any garment while in the refueling area. Antistatic finishes are not permanent and are gradually removed by laundering or dry cleaning. In addition, antistatic finishes are not as effective in low humidity conditions or at low temperatures. Moisture increases the electrical conductivity of clothing and this is why high humidity conditions minimize static build-up problems. Body perspiration has the same effect by adding moisture to undergarments and outer clothing. Insulated foot wear limits the dissipation of static charges to the ground. Both rubber soles and composition soles are relatively poor conductors but most have sufficiently low resistances to dissipate static charge. The same is true for gloves. In most cases, personnel can dissipate static charges through gloves or soles, but, as an added precaution, personnel should touch a grounding/bonding point with their bare hand. Personnel wearing Chemical Warfare Defense Ensembles (CWDEs) do not need to remove any clothing to dissipate static buildup. They can adequately ground or bond themselves directly through the CWDE boot or glove. Clothing having a surface resistivity of less than 10^{12} ohms per square or an inside-to-outside resistance of less than 10^{10} ohms will dissipate static charges through normal grounding procedures or equalize static charges through normal bonding procedures. Many aircraft have avionics Line Replaceable Units (LRUs) having electronic components that are sensitive to static discharges. When removing or replacing these units, personnel should electrostatically equalize themselves with the aircraft prior to touching the LRUs. The preferred contact/equalization point is just inside the applicable avionics bay. When handling or carrying the LRUs, avoid touching any connector pins or jacks because they might be directly connected to sensitive electronic components. Any connector or jack caps/covers should be installed whenever the LRUs are disconnected from the aircraft. Once the LRUs are in the avionics shop for repairs, standard safeguards as outlined in MDS specific technical orders and TO 00-25-234 will suffice to prevent electrostatic damage. When handling munitions or explosive devices, avoid touching bare electrical primers, exposed propellants, and explosive chemicals.

2.6 TANK FILLING.

During the tank filling process, the electrical potential of the liquid fuel surface may reach thousands of volts. A spark may discharge from the surface of the liquid to the internal surfaces of the tank or any other object in the tank such as piping, fittings, or foreign material. If the fuel vapor-air mixture above the liquid surface is in the explosive range, such a spark will provide ignition with disastrous results. Objects in a fuel tank will collect a charge from the fuels and become

similar to an electrical condenser (capacitor) plate. The potential required for a discharge from these floating objects to the tank is less than that required to cause a discharge from the liquid surface to the tank. Therefore, the hazard is greatly increased by the presence of such objects. The Air Force now incorporates a conductivity additive to decrease the relaxation time of electrostatic charges in order to preclude these problems. Also, the use of a higher flash point fuel such as JP-8 or JP-5 in lieu of JP-4, when permitted by the applicable aircraft technical orders, reduces the vapor ignition hazard. Research has suggested that if fuel flow is kept below the following maximum rates, hazardous levels of static electricity charges will not occur:

NOTE

These limits do not apply for JP fuels having antistatic additives with at least 50 Conductivity Units (CU).

Nozzle/Hose/ Pipe Diameter	Gallons/Minutes
0.75 inches	32
1.50 inches	125
2.00 inches	225
2.50 inches	352
3.00 inches	470
4.00 inches	627
5.00 inches	783
6.00 inches	940

2.7 LIGHTNING.

Even if an aircraft were statically grounded, a severe hazard to servicing personnel could exist if lightning strikes the aircraft or within several hundred feet of the aircraft. Servicing personnel should be evacuated from the area when there is danger of a direct or close proximity lightning strike. Personnel inside an aircraft will be in no danger as long as all aircraft doors, hatches, and canopies are closed. Potentials in the range of several million volts exist between clouds and earth. High points such as vertical stabilizers and antenna masts are most susceptible to strikes. These strikes are of short duration (approximately 1/100 second duration per strike) and even though high energy levels exist, the ramp grounding system will generally conduct the energy safely to earth. An electrical storm can be dangerous even if several miles from the servicing area.

2.8 OTHER SOURCES OF STATIC ELECTRICITY.

Operating aircraft engines, rotor blades, and propeller blades, can generate high static electricity voltages. These static sources are especially hazardous because the static voltages may be generated continuously as long as the engines/blades continue to operate.

2.9 GROUNDING AND BONDING POLICY.

Grounding is not required for parked aircraft or aircraft fuel servicing operations unless required by specific MDS technical orders. Aircraft will be bonded to fuel servicing equipment at all times during fuel servicing operations. Hydrant fuel servicing vehicles and hose carts will also be bonded to the hydrant system in addition to bonding to the aircraft. (This hydrant-servicing vehicle or hose cart bonding requirement applies only when the aircraft is not grounded.)

WARNING

When applicable, aircraft/equipment must be grounded and/or bonded prior to connecting the single point nozzle to the aircraft; however, the hydrant coupler will be connected to the hydrant outlet prior to bonding the hydrant servicing vehicle to the aircraft.

CAUTION

Grounding/Bonding clamps/plugs shall not be allowed to drag across the ramp. Clamps/plugs shall be carried to reels on equipment.

NOTE

- If the bonding wire becomes disconnected, reconnect it immediately. The sequence makes no difference.
- Bonding is not required for all-metal pantograph, as long as there is a continuous metal structure from the fuel servicing equipment to the aircraft.

a. Grounding of aircraft or supporting servicing equipment during either fuel servicing, Liquid Nitrogen (LIN) servicing, or Gaseous Nitrogen (N_2) servicing is not required. Recent electrostatic studies have demonstrated that grounding aircraft or supporting servicing equipment for these situations is unnecessary. Unless required by specific MDS technical orders, grounding is not required for aircraft except for the following four operations (only one grounding wire is necessary):

(1) Undergoing munitions loading/unloading operations. Aircraft grounding is not required for driving/carrying on munitions or hazardous cargo onto cargo aircraft.

(2) Undergoing electrostatic painting, bead blasting or fuel system repair.

(3) Connected to a hangar electrical power source. (This requirement does not apply to portable ground power units, including MD/4MO mobile electric power units, inside hangars.) Locations with low humidity may want to ground an aircraft one time after landing to dissipate any static charges generated on the aircraft while flying through dust or precipitation. This will be accomplished by momentarily connecting a cable from an earth ground to any unpainted metallic aircraft surface.

(4) Or when required by specific MDS technical data.

b. Overwing (open port) fuel servicing operations require a bonding wire between the fuel source and the aircraft, and a separate bonding wire for each open port fuel nozzle. The first bonding wire equalizes static charges that accumulate while fuel is flowing during fuel servicing operations. If the nozzle is attached to a conductive braided hose, this first bonding wire is not necessary. The second bonding wire prevents a charged fuel nozzle from creating a spark at the open fuel port when the fuel nozzle first touches the aircraft. Ladders used for overwing refueling do not require bonding to the aircraft.

c. Drop, external, ferry, Benson, and weapons bay fuel tanks do not need to be grounded when stored, parked, or during other periods when in-tank work is not being accomplished.

d. The connecting of more than one grounding/bonding cable by any means (clamp-to-clamp, clamp-to-handle, etc.) using any method (stacking, piggy-backing, nose-to-nose, etc.) is not authorized, except as specified in (1) or (2) below.

(1) A conversion jumper may be constructed to provide bonding capability for over-the-wing fuel servicing nozzles when aircraft to be serviced are not equipped with electrical jack assembly receptacles. Conversion jumpers will be made from only the parts listed below and assembled as follows: connect an electrical ground wire rope (cable), NSN 4010-00-575-6234 or NSN 4010-00-286-2681, to terminals of a female extension jack, NSN 5935-00-432-9340; cut electrical ground wire rope (cable) to length required; place a red warning streamer, NSN 8345-00-673-9992, on cable and then install an electrical ground clip, NSN 5999-00-134-5844 or NSN 5999-00-204-8350 on free end of cable. Perform a continuity check to make sure conversion jumper is electrically interconnected throughout assembly.

(2) A multiple receptacle junction box may be constructed to reduce the number of grounding/bonding cables around a work site. The multiple receptacle junction boxes must be built from a high quality conductive material. The receptacles installed in the junction box must be female extension jacks, NSN 5935-00-432-9340. All multiple receptacle junction boxes will be given a continuity test at the time of fabrication and at any time afterwards when a lack of continuity is suspected due to damage or corrosion. Resistance between the body or frame of the junction box and the installed female extension jacks shall not exceed 10 ohms.

2.10 GROUNDING.

The recommended connection sequence to ground an aircraft using a clamp-plug unit is (1) attach a grounding clamp to the earth grounding point, (2) insert the plug of the other end of the clamp-plug unit into an aircraft receptacle jack assembly or attach the clamp of the other end of the clamp-plug unit to an unpainted metal portion of the aircraft. An aircraft external tank can be used as a single grounding/bonding attachment point.

2.11 AIRCRAFT INSTALLED ELECTRICAL RECEPTACLES FOR GROUNDING AND BONDING.

Aircraft system managers, in coordination with lead commands, shall ensure applicable aircraft technical orders include a requirement to inspect aircraft electrical receptacles during or at appropriate maintenance interval or after receptacle maintenance. The inspection methods and frequency will also be included in the specific aircraft technical orders. In the absence of any inspection methods listed in aircraft technical orders, receptacles will be inspected and tested in the following manner:

a. Visually inspect for loosely mounted receptacles and evidence of corrosion on washers, lugs, nuts, and the aircraft skin. There shall be no free axial movement of the contact tip in the plug due to clearance between the contact (spring) tip and plug. Free axial movement indicates the contact spring is not maintaining a proper connection with the plug.

b. Inspect and test for electrical resistance as follows:

(1) Electrical resistance between receptacles and clean aircraft skin shall be one ohm or less on an 815AFA bridge or equivalent.

(2) A stainless steel plug, PN MS3493, NSN 5935-00-572-5174, will be inserted into the receptacle jack assembly. Check to ensure it is firmly seated. Electrical resistance measured between the plug

and cleaned aircraft skin must be one ohm or less, but not zero. The aircraft technical order is applicable if it specifies a value less than one ohm. A clamp, PN M83413/7-1, may be substituted for the steel plug on aircraft not equipped with the jack assembly, PN MS90298, when attached to designated grounding lugs on an unpainted part of the aircraft landing gear.

(3) A firm pull will be required to withdraw the plug from the receptacle. Approximate pull will measure 8 - 14 pounds on a spring scale, NSN 6635-00-578-5286, or equivalent. A pull of less than eight pounds indicates a weak or damaged receptacle and will be replaced. A pull of over 14 pounds indicates a possible corroded receptacle which might warrant replacement.

NOTE

A locally fabricated tool assembly may be used to assist in resistance test on aircraft installed grounding/bonding receptacles. The assembly consists of a grounding/bonding plug, NSN 5935-00-572-5174, grounding/bonding cable, NSN 4010-00-286-2681, six inches in length, and a wire rope swaging sleeve, NSN 4030-00-132-9163. Assemble as follows: install one end of six-inch grounding/bonding cable into grounding/bonding plug jam nut. Using opposite end of six-inch grounding/bonding cable, form a loop ending near grounding/bonding plug jam nut. Secure loop by placing both ends of grounding/bonding cable in a wire rope swaging sleeve and crimp. The loop can now be used as connection point for spring scale to conduct pull resistance test.

(4) Defective jack assemblies will be replaced with PN MS90298 receptacles. Latest assembly has a one-half inch curved base on contact. Outdated aircraft jack assemblies which are to be replaced are one-fourth inch across contact base with two solder lugs and a right angle bend near the end of contact.

(5) For receptacles PN 8240704-1 a firm pull will be required to withdraw the plug from the receptacle. The approximate pull force is 8 ±2 foot pounds. A pull force of less than six pounds indicates a weak or damaged receptacle. A pull force of 10 foot pounds or greater indicates a possible corroded receptacle which might warrant replacement of receptacle.

c. After receptacles meet the criteria outlined in step b., continuity check will be accomplished to assure all are electrically interconnected through the aircraft airframe and/or skin. For this test, use a portable static grounding/bonding cable. Resistance of the portable grounding cable shall be balanced out prior to use. In all cases, the resistance between receptacles should be one ohm or less.

2.12 GROUNDING/BONDING HARDWARE.

The following hardware items will be used and inspected as indicated:

a. Clamp (PN M83413/7-1). Replace clamp if jaws are deformed, spring is weak, or other defect is evident that would prevent a good connection. The M83413/7-1 will be used unless there is insufficient space in a ground connection pit. If an M83413/7-1 will not fit, then a robust ‘alligator’ type clamp can be used. Refer to AFI 21-101 Chapter 14 14.41.3 Grounding Wires/points 14.41.3.1. Two Allen head screws, or equivalent, will be utilized to secure cable to grounding clip/clamp. Unused screws will be removed.

b. Plug (PN MS3493 only). Inspect the electrical ground/bond plug for corrosion, weakness, or loose nut and replace if heavily dented or deformed, particularly around the portion which connects with the aircraft grounding/bonding receptacle.

c. Cable (3/32 inch, NSN 4010-00-286-2681 or NSN 1640-00-575-6234 only). Replace cable if more than one-third of the cable wires are broken. If electrical continuity is suspect, the cable will be checked and repaired if found to be bad.

NOTE

Deteriorated plastic coating does not affect the electrical capability of the cable.

d. Clamp-Plug Unit. The primary unit used by Air Force activities consists of a clamp and plug attached to opposite ends of a sufficient length of 3/32-inch cable. The unused handle of the clamp can be equipped with a sufficient length of 3/32-inch cable terminating into a plug. A warning streamer “REMOVE BEFORE FLIGHT” will be attached to the plug end of the cable. Other clamp-plug unit configurations may be used as mission needs dictate as long as specified hardware is used to construct them. The cable retainer (cap) of the two-piece plug and cap assembly design may be spot welded to prevent loosening of the cable and possible loss of continuity.

e. Locally-fabricated clamp-plug units will be checked with a multimeter for continuity prior to being placed into service. The continuity check test points should be from the inside of clamp jaws to end of plug. A continuity check should be performed any time a lack of

continuity is suspect due to corrosion buildup or damage. A nominal 100-foot length of 3/32-inch diameter stainless steel cable will have a maximum allowable resistance of 10 ohms.

f. When grounding is required for bare base operation, grounding rod, NSN 5975-00-240-3859, will be used.

g. Static Grounding/Bonding Reel Inspection Criteria. All installed static discharge reels shall be given a continuity test at the time of initial installation and at any time a lack of continuity is suspected due to damage or corrosion. The test will be accomplished by extending the entire length of the cable and measuring the continuity between the plug or inside the clamp jaws to the equipment frame on which the reel is mounted. Resistance between these two points shall not exceed 10 ohms. Prior to each use, the grounding reel shall be visually inspected for security of mounting on a rigid base and evidence of any corrosion or damage.

2.13 PERSONNEL GROUNDING/BONDING.

Personnel will use grounding or bonding techniques to dissipate or equalize static charges that have accumulated during ground servicing operations. During an aircraft fuel servicing operation, a static spark in the wrong place could ignite a fuel vapor concentration. Fortunately, normal fuel servicing operations have ignitable flammable vapor concentrations only near aircraft fuel vent outlets. These vapor concentrations generally dissipate rapidly to levels that are too lean to be ignited. An aircraft fuel system failure, however, could result in fuel spilling from vent outlets or from other locations. This increases possibility of an ignition from a static spark. Therefore, prior to any fuel servicing or munitions loading/unloading operation, personnel involved in the operation will ground or bond themselves to a suitable grounding/bonding point or to a bare (unpainted) portion of the aircraft to uninsulated portions of the aircraft grounding wires. This bonding point should be at least three feet from any aircraft fuel vent outlet. If a spark occurs during the initial grounding or bonding procedure, then atmosphere conditions are ideal for additional static charge accumulations; therefore, under this condition, personnel will ground or bond themselves periodically. If no spark occurs during the initial grounding or bonding procedure (or other symptoms do not occur), then additional grounding or bonding is not necessary. All personnel will avoid grounding or bonding themselves within three feet of aircraft fuel vent outlets. In addition, personnel conducting aircraft fuel vent checks will ground or bond themselves above waist level and at least three feet from fuel vent outlet prior to checking vent. Weapons loading personnel will ground or bond themselves when entering fuel servicing safety zone and before handling electrically-primed munitions. Always avoid touching the primers of electrically-primed munitions (i.e., impulse cartridges and 20 MM ammunition). Personnel entering a fuel servicing or weapons loading area should also ground or bond themselves to the closest piece of grounded or bonded aircraft or equipment.

2.13.1 Chemical Warfare Defense Ensemble (CWDE) Resistance Tests. CWDE resistance tests have shown that static charges can be effectively dissipated through CWDE gloves (preferred) which have resistances of approximately 10,000 ohms. Personnel can ground or bond themselves directly through the glove of CWDE; therefore, removal of any of the ensembles for grounding or bonding purposes is not required.

2.13.2 Servicing Fuel with Personnel Armor ((Flak Vest) or Individual Body Armor (IBA)). When servicing aircraft with low flashpoint fuels (JP-4, Jet B, AVGAS, or MOGAS), personnel armor should not be worn while performing fuel servicing operations except in actual combat. Tests have shown that static charges cannot be effectively dissipated by normal grounding or bonding procedures. Personnel armor acts as an electrical insulator with an extremely high resistance. Personnel armor will generate and accumulate a static charge during a person's normal movement. This accumulated charge will then be equalized on the person's body. When normal grounding or bonding procedures are used, the charge on the person's body will be dissipated or equalized, but the charge on the personnel armor will not. An individual wearing personnel armor will always ground or bond himself when approaching an aircraft and prior to beginning work. If no spark occurs during bonding or grounding, then conditions are not present to accumulate a static charge with sufficient energy to be hazardous; therefore, normal work may begin. If a spark does occur during bonding or grounding, the individual will ground or bond frequently during all work phases.

CHAPTER 3
GENERAL PROCEDURES

3.1 HOUSEKEEPING.

A clean work area makes a safer, more efficient operation. High standards of cleanliness shall be maintained in the hazardous environment of aircraft ground servicing. Aircraft parking areas, servicing aprons, fuel servicing vehicles/equipment, and Support Equipment (SE) compartments and surfaces shall be kept free of debris and accumulation of oil, hydraulic fluids, grease, or fuel. Personnel shall not be subjected to increased risk to catch servicing fluids. If a spill occurs, it shall be controlled in accordance with local directives once the aircraft and surrounding area are made safe. Safe fuel servicing depends on keeping fuels in controlled areas, not allowing spillage, and in keeping all ignition sources away from designated servicing areas.

3.2 AIRCRAFT FLUIDS AND FUELS.

The servicing of aircraft jet fuels, hydraulic fluids, and lubricants, presents a potential fire or explosion hazard. Flammable mixtures can be formed by the vapors from JP-4 fuel, or from a spray or mist from a pressurized leak. Flammable vapors are present when the temperature of JP-4 fuel is greater than -10 °F. The vapor concentration depends on both the fuel temperature and the ambient temperature. As the temperature increases, the vapor concentration increases. The temperature at which the concentration of vapors is sufficient to form a flammable mixture without propagating is known as the flash point temperature (-10 °F for JP-4). The term Lower Flammable or Explosive Limit (LFL or LEL) is the minimum concentration of vapor-to-air where flame will occur with an ignition source and continue to propagate. The Upper Flammable or Explosive Limit (UFL or UEL) is the maximum vapor-to-air concentration above which propagation of flame will not occur. These flammability limits (1.3 percent to 7.0 percent by volume) are established under controlled laboratory conditions and are not directly applicable to servicing of aircraft. The fuel vapors, being heavier than air, tend to cling to the ground. At some distance above the fuel surface, the mixture of fuel vapors and air is flammable. Therefore, it is necessary to treat any JP-4 fuel spill as being flammable. For comparison, JP-8 fuel has a much higher flash point and is relatively safer to use. The flash point of JP-8 is +100 °F, if the fuel temperature is less, JP-8 vapors will not be present above the surface of the fuel. Special care is still required for JP-5 and JP-8 fuels because many of the current Air Force aircraft use the fuel as a heat sink. These aircraft may have JP-5 and JP-8 fuel at 160 °F well above the flash point. Even during concurrent or hot refueling operations the temperature of the JP-5 and JP-8 may be well above the flash point and will behave just like JP-4.

3.3 REFUELING.

Pressurized refueling operations present a potential hazard for pressure leaks in equipment, pipes, and hoses. These failures may cause a fine spray or mist to be present. If there is an ignition source, there could be a fire regardless of the fuel's flash point temperature. Constant vigilance is needed to eliminate potential ignition sources from the servicing operations. A very small energy spark, for example, can ignite JP-4 fuel vapors. The energy associated with metal tools being dropped on concrete, sparks generated when grounding or bonding equipment, static electricity generated by personnel, the arcing of electrical/mechanical equipment, and sparks/hot particles from an engine exhaust will ignite JP-4 fuel vapors. The less volatile petroleum products, such as JP-5 or JP-8 fuels, hydraulic fluids, or lubricants will not normally ignite unless the fluid is in direct contact with the ignition source. However, when JP-5 and JP-8 are discharged under pressure as a mist or spray, it can ignite/flash as readily as JP-4. Open flames, electrical arcing, and hot surfaces are all potential ignition sources.

3.4 HOT SURFACES.

During refueling operations, the most common ignition sources present are hot surfaces above 750 °F, such as hot brakes, bleed air ducts, hot engine, and APU surfaces. In many servicing operations, the hot surface may be present on the support equipment. If any heated metal object glows at all (any color) then its temperature is at least 900 °F and therefore it is an ignition source. Once a fire starts, the spread is quite rapid. The flame temperature is approximately 2000 °F and is well in excess of the melting temperature of aluminum alloys (1000 °F). Therefore, it is necessary to have fire fighting equipment immediately available as specified in Table 3-1.

3.5 SERVICING SUPERVISOR.

Fuel and water servicing will be conducted under the direct control of the servicing supervisor. This supervisor will be completely familiar with this technical order and the applicable aircraft -2 technical order(s). In addition, this supervisor must demonstrate a thorough knowledge of all equipment and systems involved in the servicing operations and be qualified/certified in accordance with command directives. This supervisor will insure that all applicable safety precautions and technical order requirements are taken and/or observed prior to, during, and after all servicing operations. This supervisor shall be responsible for assigning, monitor-

ing, directing, and controlling the duties of personnel under his or her supervision as follows:

a. Check the markings on the refueling equipment to verify that the correct grade of fuel is being supplied to the aircraft.

b. Control the movement and correct positioning of aircraft and servicing equipment to, from, and within the servicing areas.

c. Verify the positioning and type of fire extinguishers.

d. Evacuate non-essential personnel and equipment.

e. Shut down powered SE not essential to servicing. If necessary, move SE to a point where it will not obstruct operations.

f. Verify that the correct grounding/bonding sequence is accomplished.

g. Establish and maintain either visual or voice contact with the control panel operator and/or servicing equipment operator(s). If the aircraft is equipped with intercom communications for ground operations, it will be used to maintain, voice contact with fuel panel operator(s) at all times during servicing.

NOTE

For commercially contracted cargo-only aircraft where the fuel control panel/fuel system control mechanism is located on the outside of the aircraft, use of the aircraft intercom system by servicing ground crews is not required. If any personnel (flight or ground crew members) are to remain on board the aircraft during fuel servicing operations, then voice contact must be established and maintained between the personnel remaining on board the aircraft and the fuel control panel operator(s) at all times during the fuel servicing operation.

h. For single point servicing, the fuel servicing supervisor will ensure the Single Point Receptacle (SPR) nozzle is properly connected to the aircraft fueling receptacle.

NOTE

Connect the SPR nozzle to the aircraft. With the SPR nozzle crank handle in the closed position, check the strainer coupling quick disconnect device for positive locking. Prior to pressurizing the hose, be sure the nozzle is securely locked to the aircraft by attempting to remove the nozzle with the nozzle crank handle in the open position. 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. On aircraft with Refueling Teams, the team member connecting the refueling receptacle will be responsible for testing the strainer quick disconnect locking device for positive engagement and assuring the refueling nozzle is securely locked.

i. During over the wing/open port fuel servicing, ensure the nozzle bonding wire is installed prior to opening the filler cap and that the fuel nozzle operator does not block or jam the nozzle in the open position or leave it unattended.

j. Ensure communication is available through Maintenance Operation Center (MOC) and/or the Command Post to Fire Protection Agencies.

k. Ensure personnel are thoroughly familiar with and qualified to perform safe servicing operations.

l. Implement immediate shut down procedures if an abnormal condition (i.e., power loss or fuel gage malfunction) occurs during fuel servicing.

3.6 FUEL SERVICING SAFETY ZONE (FSSZ).

This is the area within 50 feet of a pressurized fuel carrying servicing component; i.e., servicing hose, fuel nozzle, SPR, hydrant hose cart, ramp hydrant connection point, etc., and 25 feet around aircraft fuel vent outlets. The FSZZ applies to open ramps and to the insides of hangars and shelters. (Aircraft interiors are not considered part of the FSSZ unless canopies, ramps, or doors are open exposing part of the aircraft interior to a spilled or sprayed fuel hazard.) The fuel servicing safety zone is established and maintained during pressurization and movement of fuel. See Figure 3-1 for an example of the bomber pit refueling safety zone and Figure 3-2 for an example of the fighter refueling safety zone. During fuel movement, active ignition sources shall be removed and kept out of the fuel servicing safety zone. Some examples of active ignition sources are open flames, sparks from internal combustion engines, and electrical arcing. Non-servicing vehicles and AGE Equipment (with engines not running) are allowed to be parked within the Fuel Servicing Safety Zone as long as they do not prevent the emergency egress of the servicing equipment or personnel.

3.7 THE AIRCRAFT BEING SERVICED.

Non-essential aircraft electrical systems, including radar, shall not be activated on the aircraft during servicing operations unless absolutely required for servicing. However, if required, aircrew members may operate UHF/VHF cockpit radios. The power off portion of aircrew walkaround inspections may be performed when essential to meet established operational turnaround requirements.

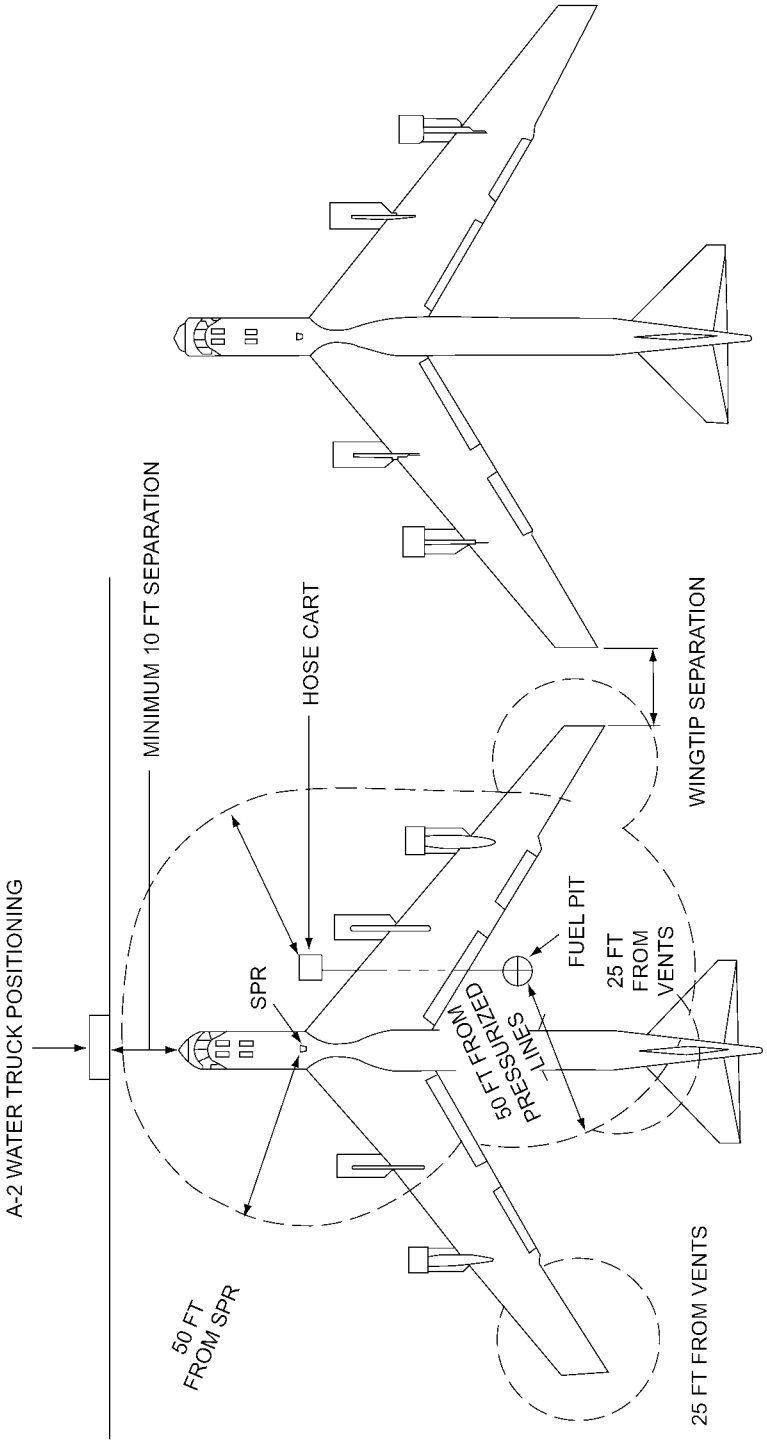

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Figure 3-1. Bomber Refueling Safety Zone Example

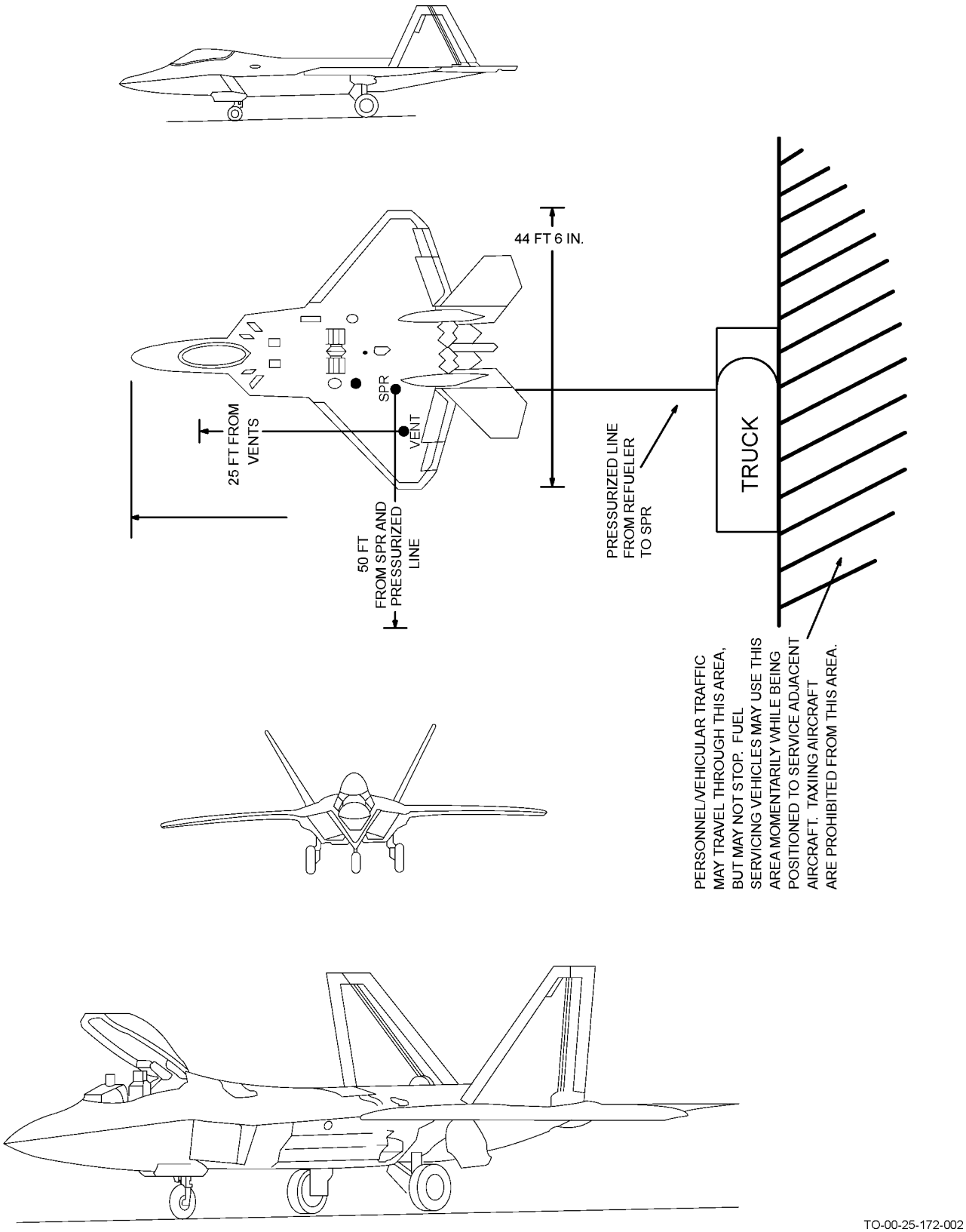

Figure 3-2. Fighter Refueling Safety Zone Example

3.8 ADJACENT AIRCRAFT.

Aircraft parked as prescribed in AFH 32-1084 and which intrude into the fuel servicing safety zone shall not be:

a. Involved in engine starts or engine trim operations.

b. Radiating electromagnetic energy.

c. Using NDI or welding equipment.

d. Involved in any maintenance requiring:

(1) Energizing or de-energizing external electrical circuits.

(2) Disconnecting combustible fluid carrying lines, except those equipped with non-spill, quick disconnects.

e. Moved under its own power.

NOTE

However, normal maintenance, including pre/post-flight inspections involving internal aircraft electrical power, may be performed on adjacent aircraft providing there are no spilled flammable liquids.

3.9 SERVICING CONSTRAINTS.

The following constraints apply during servicing operations:

a. During servicing, only those personnel actually required for the operation shall remain in the fuel servicing safety zone. Aircrew on commercial contract cargo-only aircraft may remain on board the aircraft during servicing operations. Aircrews on MAF aircraft may remain on board the aircraft during servicing operations. Passengers may remain on MAF aircraft as long as the provisions of Chapter 5 are met. Personnel receiving training on specific tasks required to complete the fuel servicing operation are allowed in the FSSZ if they are under the direct control and supervision of the fuel servicing supervisor. Quality inspectors may enter the FSSZ to perform quality assurance functions. Personnel performing authorized functions on adjacent aircraft, which intrude into the FSSZ, may remain on duty with the adjacent aircraft. The servicing supervisor will coordinate with all affected personnel so that these restrictions are observed. There shall be no smoking within 50 feet of any aircraft or servicing operation. Servicing operations shall not begin if any indication of “hot brakes” are noted.

b. Aircraft radar and High Frequency (HF) radios shall not be operated in the transmit mode within 300 feet of servicing operations, unless otherwise specified in the applicable aircraft and equipment repair technical orders, or when TO 31Z-10-4 procedures are used to ensure a safe distance. Satellite communications (SATCOM) radios may be operated in the transmit mode if the antenna beam is pointed at least ten degrees above the horizon.

c. Do not start servicing operations (any movement of fuel, water, environmental fluid, oil, hydraulic fluid, oxygen, nitrogen, or hydrazine) whenever one of the following conditions exists. If servicing operations are already in progress, terminate as soon as practical:

(1) When a lightning advisory has been issued indicating an electrical storm is within five nautical miles (5.75 miles) of the servicing area.

(2) Winds reach velocities hazardous to the aircraft or servicing operations. Specific high wind restrictions will be developed by base-level personnel for each base supporting a flying mission.

(3) Fire in the vicinity is generating hot ashes.

(4) In those cases where on-scene fire protection is required, if an aircraft crash/fire occurs at the same airfield, servicing operations already underway will be stopped and fuel servicing equipment will be disconnected. No new servicing operations will be started until the crash/fire is declared under control by the base Fire Chief or Senior Fire Officer (SFO), his designated representative, or the on-scene commander, and the required level of fire protection is available to support servicing operations.

(5) In those cases where on-scene fire protection is required, in the event of an In-Flight Emergency (IFE) or crash warning resulting in the departure of the on-scene fire vehicle, servicing operations already underway must be stopped. No new servicing operations may be started without the concurrence of the base Fire Chief, his designated representative, or the on-scene commander, or until the IFE or crash warning has been cancelled. As a condition of continuance during IFEs, either an operational fixed, skid mounted, or portable Aqueous Film Forming Foam (AFFF) fire suppression system discharging through oscillating nozzles or at least one fully manned aircraft rescue and fire fighting vehicle must be positioned at the aircraft fuel servicing scene.

WARNING

In freezing weather, touching a metal surface with bare skin can cause the skin to stick to the cold surface, resulting in a painful injury. One way to avoid this is to touch the aircraft grounding/bonding connector with a warm metal object, such as a coin held in the bare hand.

d. Personnel in the FSSZ shall not wear footwear with exposed spark-producing nails or metal plates on the walking surfaces. Any type of clothing may be worn as outer garments when fuel servicing aircraft with high flash point fuels (JP-5, JP-8, JP-10, JET A, JET A-1, TS-1 below 82 °F, or diesel). However, when fuel servicing aircraft with low flash point fuels (JP-4, JET B, AVGAS, or MOGAS), clothing containing more than 65% of any combination or mixture of nylon, rayon, wool or polyester shall not be worn as outer garments. Do not put on or remove outer garments in the fuel servicing safety zone. Matches or lighters will not be handled or removed from pockets during servicing operations. If flight crew members wearing Nomex and/or other authorized flight clothing are required to assist in aircraft fuel servicing operations, they will first assure that they are at the same potential as the aircraft. This is done by bare hand contact with the aircraft grounding/bonding connector, an unpainted aircraft surface, or a static ground before removing the fuel filler cap or while inserting the bonding jack on the fuel nozzle. These requirements also apply to draining aircraft fuel sumps.

e. Laptop computers (including wireless versions), portable digital assistants, pagers, cell phones, stray voltage detection devices, radios, night vision goggles, flashlights (six volts or less), cameras (including digital cameras), and Pelican Advanced Area Lighting Group (AALG) can be operated within the FSSZ. Camcorders may also be used in the FSSZ as long as the cathode ray tube viewfinder (eyepiece) is de-energized. However, no battery changes nor charging operations are allowed within the FSSZ. Only night vision goggles and intrinsically safe (Paragraph 1.2.26) devices can be operated within 10 feet of aircraft fuel vent outlets, open port refueling receptacles, fuel spills, or fuel trucks being filled (bottom loading or from aircraft defueling). All other devices e.g., cell phones, must be turned off (not placed on standby) when within this ten foot zone. Earmark Series 4C headsets, Trulink wireless intercom and cordless Aircraft Wireless Intercom Systems (AWIS) constructed by Communications - Applied Technology may be used anywhere within the FSSZ. Centralized Aircraft Support Systems (CASS) can remain energized in the FSSZ, but electrical switches must not be operated.

f. If hot brakes are suspected, an aircraft hot brake check will be performed prior to fuel servicing. Temperature can be measured by temperature sensitive substances (temp sticks) or by infrared heat sensors. Fuel servicing shall not start until the brake temperature is below 750 °F, except for the A-10, C-5, C-17, C-130, C-141, E-4, F-15, and HH-60 aircraft. These aircraft are exempted because of the location, direction, and distance of the fuel vent outlets from the aircraft landing gear brake assemblies. The F-22 can be refueled with brake temperatures exceeding 750 °F if an adequate shield is used to keep vented fuel from reaching the left main landing gear brake assembly.

g. If glowing or crackling fuel is noted when servicing aircraft, immediately cease all servicing operations. Report the incident to the servicing supervisor and to the fire department. After the incident is investigated, recheck grounding connections, and resume flow at a slower rate and pressure.

h. Operating external power units will be parked outside the fuel servicing safety zone which is at least 50 feet from the pressurized fuel carrying servicing components and at least 25 feet from aircraft fuel vent outlets. The operating units will be positioned upwind from the fuel servicing operation when possible.

CAUTION

The aircraft settles as fuel is taken on board. Ensure adequate clearance exists between the aircraft and maintenance stands or equipment positioned under any portion of the aircraft.

NOTE

Fiberglass is a non-conductive material (insulator) that does not dissipate or transfer electrostatic charges when either grounded or bonded to conductive objects. Therefore, the grounding or bonding of fiberglass ladders or work stands is not required.

i. Bond conductive aircraft maintenance or work stands to the aircraft when using the stand to access the aircraft fuel servicing receptacles or support the fuel hose

during servicing operations. Other maintenance or work stands, not used for fuel servicing, do not require either bonding or grounding. Ladders used for overwing refueling do not require bonding to the aircraft.

WARNING

If any tank appears to fill abnormally slow or not at all, then stop all refueling immediately and investigate to determine what is causing the problem. The cause could be a blocked vent line or failed refuel shutoff valve or other malfunction.

j. On aircraft equipped with individual fuel tank quantity gauges, monitor each gauge during refueling operation.

k. Fuel servicing hoses can be routed under aircraft, but avoid placing them near running engines and Auxiliary Power Units (APU). If possible, avoid placing hoses forward of the aircraft landing gear, in case the aircraft needs to be towed away for an emergency. For concurrent servicing operations, place hoses to minimize damage from other servicing equipment.

l. Ensure that the aircraft is properly chocked. Use MIL-PRF-32058 or equivalent chocks.

3.10 SERVICING VEHICLES AND SUPPORT EQUIPMENT (SE).

Do not service aircraft if any of the following safety discrepancies exist:

a. Defective servicing hose.

b. Fuel leaks.

c. Defective or bare electrical wiring.

d. Defective throttle or PTO Interlock System.

e. Defective hand or foot brakes.

f. Defective exhaust system.

g. Aircraft or support equipment engine(s) is (are) overheated.

h. Defective or inoperative emergency shutoff switch.

i. Defective shift linkage or gear shift indicator.

j. Defective tank vent valves.

k. Vehicle air pressure below 90 psi.

l. Vehicle or support equipment engine backfires.

m. Fuel filter pressure exceeds maximum authorized differential pressure (coalescing; 15 psig, absorption of 15 psig).

n. Defective deadman control valve.

o. Defective nozzle.

3.11 FIRE PROTECTION.

Fire protection is essential during aircraft servicing operations. The level of fire protection is based on the hazard involved in the operation being conducted. Personnel involved in servicing operations shall be trained in the operation of fire extinguishers and installed fire suppression equipment systems. In the event of a fire or fuel leak, servicing personnel are the first line of defense in protecting Air Force assets involved when fire department personnel are not available at the incident scene. Servicing personnel must immediately notify the fire department and use available fire extinguishers (or other equipment) until the fire department arrives on scene.

NOTE

Avoid placing fire extinguishers within 25 feet of the aircraft fuel vent outlet(s) during fuel servicing operations. Refer to the aircraft specific technical order for placement during fuel servicing.

a. Fire extinguishers placement. The 150-pound, Halon 1211 fire extinguisher is the primary flight line fire extinguisher. Fire extinguishers should be placed where they present optimal aircraft and personnel safety while the aircraft is parked and during taxiing operations. The preferred placement will be near the aircraft wing tip, consider pilot view, wing tip clearance while parked, wing tip clearance during taxi, and ease of access to most probable fire areas when determining placement of the fire bottle. Fire extinguisher requirements are outlined where appropriate in applicable paragraphs of this technical order and are summarized in Table 3-1.

b. Installed Fire Suppression Systems and Vehicle Standby. Certain aircraft servicing operations present increased hazards and require a greater level of fire protection awareness and standby posturing. Hot refueling operations require modular or installed fire suppression equipment employing AFFF. When such systems are not available, fire protection is provided by standby fire fighting vehicles and crews. Refer to applicable information in this technical order and to Table 3-1 for a summary of installed fire suppression system requirements and vehicle standby requirements.

c. Fire Department Standby Requirements. Table 3-1 lists various fire protection requirements for Aircraft Rescue and Fire Fighting (ARFF) vehicles. Due to a limited amount of ARFF equipment available, on occasion the fire chief or SFO is required to direct standby vehicles to emergencies. An example is when the fire department responds to an IFE. During IFEs, ARFF vehicles are pre-positioned along the runway when an emergency landing is anticipated. The following fire protection policy applies during emergency situations.

(1) Operations, which may continue. Concurrent Servicing Operations (CSO) during Combat Sortie Generation may continue fuel servicing until the present CSO is completed. No fuel servicing portion of a new CSO may begin unless authorized by the wing commander (or senior local operational commander) until the ARFF vehicle has returned to a standby posture. As a condition of continuance, there must be an immediate means of recalling the fire department in case of an onsite emergency. Additionally, two 150-pound Halon 1211 extinguishers must be located with one on each side of the aircraft. Servicing personnel shall be trained in the use of these extinguishers. Maintenance, fuel servicing, and aircrew personnel must exercise extra vigilance during this time period. When the fire chief releases the ARFF vehicles from the emergency scene, they will reservice as necessary and return immediately to a standby posture.

(2) Operations which must cease. All aircraft hot refueling operations, concurrent fuel servicing of aircraft with passengers on board, fuel servicing of medical evacuation flights with passengers/patients on board, defueling when an aircraft has a fuel leak, is damaged from fire or impact, defueling into open containers or drums, or defueling where safe distance criteria cannot be met or static grounding points are not available. These operations shall cease immediately. Fuel flow will be stopped and pressure relieved from the fueling system until the ARFF vehicle has returned to a standby posture.

(3) The fire chief or SFO is the primary individual for determining standby posturing requirements and ARFF vehicle standby locations for the various aircraft operations. This will include having an ARFF vehicle on standby status in the fire station or other location for operations listed in Table 3-1 as he deems appropriate. The goal for the fire chief is to not take away from other critical firefighter duties i.e., training, equipment maintenance, etc., while still maintaining a heightened state of alert for aircraft involved in the listed operations. Final determination for standby requirements is at the discretion of the installation commander.

Table 3-1. Fire Protection Equipment Requirements

Type of Operation	Fire Protection Requirements
WARNING • Do not use Halon, carbon dioxide, or water (Type A, B, or C Rated) fire extinguishers on or near fires involving munitions, pyrotechnics, or magnesium incendiaries (flares). Halon can be used on fires involving liquid oxygen (LOX), but it is less effective in extinguishing fires in oxygen-enriched environments; other agents, such as CO2 are preferred. The extinguishers listed in this table should only be used for initial knockdown of fires on aircraft and equipment before the involvement of munitions, pyrotechnics, or magnesium incendiaries or to protect adjacent equipment and facilities. Always ensure you have the proper fire extinguisher for the class of fire hazard encountered. • The fire protection requirements listed in Table 3-1 shall not be exceeded without approval from the Fire Protection Flight. Failure to comply with this warning could result in personnel injury or death. **CAUTION** It is preferred the 150-pound Halon 1211 wheeled fire extinguisher remains in the vertical position at all times; however, some circumstances may require it to be laid down. The laying down of the flight line extinguishers to prevent tipping or damage from engine exhaust may result in the extinguisher failing to discharge all agent to suppress a fire. If flight line personnel are concerned the fire extinguisher in the upright position interferes with aircraft operations; lay the fire bottle down. Should the extinguisher be needed, if possible, stand it upright prior to agent discharge. This will ensure all agent in the extinguisher is available for discharge. **NOTE** • All references to the Halon 1211 extinguisher are for the 150-pound wheeled extinguisher, see AFI 91-203 and TO 13F4-4-121 for inspection and operating requirements. • Fire department standby vehicle posturing is not required when the operation involves the simulation of refueling. • The fire department standby requirements contained in this TO apply for normal day-to-day operations. Under actual combat conditions, contingencies or emergencies, and MAJCOM directed and approved exercises; Concurrent Servicing Operations during Combat Sortie Generation may be conducted with only two 150-pound Halon 1211 portable fire extinguishers. • For any operations performed in SIMULATED Hardened Aircraft Shelters/Protective Aircraft Shelters (HAS/PAS), the fire protection equipment requirements will be the same as for those operations being conducted outside a hangar or shelter. • The minimum distribution of Halon 1211 extinguishers indicated in the table should not be exceeded without approval of the Fire Protection Flight.	
1. POL servicing vehicle-parking area.	The Fire Protection Flight determines the type of extinguisher required for the associated hazards in accordance with NFPA 10.
2. Aircraft outside of hangar or shelter with no servicing being conducted.	
a. A/T-38, C-12, C-21, C-27, C-29, F-5, H-1, H-60, MQ-9, T-1, T-6, T-41, M/RQ-1K/L, RQ-1K/L, and U-2.	One Halon 1211 extinguisher per three aircraft. AETC aircraft require one per two aircraft.
b. F-4, F-15, F-16, F-22, F-117, H-53, RQ-4A, OA/A-10 and V-22.	One Halon 1211 extinguisher per two aircraft.
c. Airbus A300/310, B-1, B-2, B-52, B-727, B-757, B-767, B-777, C-17, C-20, C-32, C-37, C-40/B-737, C-130, C-141, DC-9, DC-10, E-3, E-8, KC-135, L-1011, MD-90, and T-43.	One Halon 1211 extinguisher per aircraft.

Table 3-1. Fire Protection Equipment Requirements - Continued

Type of Operation	Fire Protection Requirements
d. C-5, E-4, VC-25, and B-747.	Two Halon 1211 extinguishers per aircraft.
e. Alert Aircraft: A/T-38, C-12, C-21, C-29, F-4, F-5, F-15, F-16, F-117, H-1, H-53, H-60, OA/A-10, T-6, T-39, T-41 and U-2.	One Halon 1211 extinguisher per aircraft.
f. Alert Aircraft: (Except DC-9 Series used for medical evacuation, refer to entry 3h. or 3i. when passenger(s) are on board). B-1, B-2, B-52, C-5, C-17, C-130, C-141, DC-9 Series, DC-10 Series, E-3, E-4, E-8, KC-135, T-43, VC-25, and B-747.	Two Halon 1211 extinguishers per aircraft.
3. Aircraft being serviced outside of a hangar or shelter.	
a. No powered support equipment being operated.	One Halon 1211 extinguisher per aircraft located in the Fuel Servicing Safety Zone (FSSZ). C-5, E-4, VC-25, and B-747 require two per aircraft.
b. Powered support equipment being operated.	One Halon 1211 extinguisher located in the FSSZ of the aircraft. C-5, E-4, VC-25 and B-747 requires two per aircraft. During fuel servicing, the use of aircraft APU/GTC without integral fire suppression capability will require a Halon 1211 extinguisher to be positioned in the FSSZ and to protect both the aircraft and APU/GTC exhaust port area.
c. Cargo aircraft with nuclear weapons aboard.	One Halon 1211 extinguisher per aircraft located in the FSSZ. Additionally, during loading and off loading operations, engine starts, or other aircraft servicing, a minimum of one ARFF vehicle, Air Force P-19 or equivalent ARFF vehicle meeting or exceeding P-19 capabilities is required to be in standby posture. Stand by ARFF vehicle will maintain a one-minute response time during taxi, takeoff and landing. The Base Fire Chief determines positioning for optimum response.
d. Concurrent Servicing Operations during Sortie Generation: Simultaneous refueling, munitions loading/unloading, aircraft reconfiguration e.g., tanks, racks, pylons loading/unloading, and other specified maintenance activities with all engines shut down.	In addition to the requirements of 3a. or 3b. as applicable, an ARFF vehicle (P-2//19/20/23) will be on flight line standby. It will be positioned for optimum response as determined by Base Fire Chief.
e. Hot refueling: The transfer of fuel into the fuel tanks of an aircraft with one or more engines on an aircraft operating with or without munitions on board.	One Halon 1211 extinguisher positioned between the refueling equipment and the refueling supervisor's position. In addition, either a fixed or skid mounted AFFF system discharging through oscillating nozzles. An ARFF vehicle (P-2//19/20/23) may be substituted for the AFFF system. An ARFF vehicle will be on standby posture. The Base Fire Chief determines positioning for optimum response.
f. Multiple hot refueling operations.	An ARFF vehicle will be on standby posture. The Base Fire Chief determines positioning for optimum response.
g. Concurrent fuel servicing of aircraft without passengers. (See Chapter 5.)	One Halon 1211 fire extinguisher for each SPR connection location being used. An ARFF vehicle will be on standby posture. The Base Fire Chief determines positioning for optimum response. When two or more aircraft are being concurrently serviced at different locations, an ARFF vehicle will be on standby posture. The Base Fire Chief determines positioning for optimum response.

Table 3-1. Fire Protection Equipment Requirements - Continued

Type of Operation	Fire Protection Requirements
h. Concurrent fuel servicing of aircraft with passengers (Commercial airports exempt). (See Chapter 5.)	**NOTE** The fire department shall be notified at least 15 minutes prior to starting concurrent servicing operations. One Halon 1211 fire extinguisher for each SPR connection location being used. Additionally, when servicing with JP-4 or Jet B Fuel, an installed fire suppression system is required. If it is not available, an ARFF vehicle will be on standby posture. The Base Fire Chief determines positioning for optimum response. When two or more aircraft are being concurrently serviced at different locations, an ARFF vehicle will be on standby posture. The Base Fire Chief determines positioning for optimum response.
i. Concurrent servicing of medical evacuation flights with passengers/patients on board. (See Chapter 5.)	**NOTE** The fire department shall be notified at least 15 minutes prior to starting concurrent servicing operations. The number of passengers remaining on board aircraft shall be indicated. One Halon 1211 fire extinguisher for each SPR connection location being used. Additionally, when servicing with JP-4 or Jet B Fuel, an ARFF vehicle (P-2//19/23) will be positioned at the aircraft.
j. Defueling when an aircraft has a fuel leak, is damaged from a fire or impact, defueling into open containers or drums, defueling where safe distance criteria cannot be met.	One Halon 1211 fire extinguisher for each SPR connection location being used. An ARFF vehicle will be on standby posture. The Base Fire Chief determines positioning for optimum response.
k. Rapid defueling of KC-135 aircraft.	One Halon 1211 fire extinguisher for each SPR connection location being used. If the wing tip separation is less than 50 feet, an ARFF vehicle will be on standby posture. The Base Fire Chief determines positioning for optimum response.
4. Aircraft serviced in flow through revetment.	Servicing in flow through revetments requires the same level of fire protection as servicing conducted on the ramp. (See 3 above).
5. Aircraft parked inside aircraft shelters/FTRs.	One Halon 1211 fire extinguisher inside each shelter/FTR being used.
a. Aircraft fuel servicing in shelters/FTRs.	One Halon 1211 fire extinguisher inside each shelter/FTR being used.
b. Concurrent Servicing Operations during Sortie Generation in shelters/FTRs.	Two Halon 1211 (150 lb) extinguishers. The extinguisher closer to the aircraft fuel vent should be manned. Additionally, an ARFF vehicle will be on standby posture. The Base Fire Chief determines positioning for optimum response.
c. Hot refueling.	Two Halon 1211 (150 lb) extinguishers. The extinguisher closer to the aircraft fuel vent should be manned. Additionally, an installed fire suppression system is required. If an installed fire suppression system is not available, an ARFF vehicle will be on standby posture. The Base Fire Chief determines positioning for optimum response.

Table 3-1. Fire Protection Equipment Requirements - Continued

Type of Operation	Fire Protection Requirements
d. Aircraft double-stuffed.	Two Halon 1211 (150 lb) extinguishers. Extinguishers will be positioned for optimum response to either aircraft depending upon particular operation(s) being conducted.
6. Hydrazine leak or spill.	Notify MOC. Implement base formal contingency plan in accordance with AFOSH STD 48-8. Refer to Paragraph 4.22 of this technical order for further information.
7. Wet wing defueling.	Four, 80 BC, dry chemical extinguishers (Army supplied).
8. Aircraft serviced inside A/F 37T10/11 Hush Houses.	One Halon 1211 fire extinguisher inside the hush house being used.
9. Aircraft being loaded/unloaded with non-nuclear munitions using -33-1-2 procedures with/without powered support equipment.	
a. Outside hangar or shelter.	Same as 2 above.
b. Flow through/three-sided revetment.	One Halon 1211 fire extinguisher located within each revetment being used.
c. Aircraft Shelters.	One Halon 1211 fire extinguisher inside each shelter being used.
10. Multiple source refueling.	One Halon 1211 fire extinguisher for each side of the aircraft being serviced.
11. Protective Aircraft Canopy Shelters (PACS).	Same as 2 above.
12. Refueling of aircraft not equipped with an integral APU fire fighting capability (when APU is operating).	One individual shall remain outside the aircraft within 20 feet of the APU/GTC compartment exhaust with a 150-pound Halon 1211 fire extinguisher.
13. Aircraft parked inside a hangar (aircraft containing or previously contained fuel and the tanks and fuel system have not been drained or purged).	Fire protection requirements.
a. A/T-38, C-12, C-21, C-27, C-29, F-5, H-1, H-60, T-1, T-6, T-41, M/RQ-1K/L, RQ-1K/L, and U-2.	One Halon 1211 extinguisher per three aircraft. AETC aircraft require one per two aircraft.
b. F-4, F-15, F-16, F-22, F-117, H-53, RQ-4A, AND OA/A-10.	One Halon 1211 extinguisher per two aircraft.
c. Airbus A300/310, B-1, B-2, B-52, B-727, B-757, B-767, B-777, C-17, C-20, C-32, C-37, C-130, C-141, DC-9, DC-10, E-3, E-8, KC-135, L-1011, MD-90, and T-43.	One Halon 1211 extinguisher per aircraft.
d. C-5, E-4, VC-25, and B-747.	Two Halon 1211 extinguishers per aircraft.
e. Alert Aircraft: A/T-38, C-12, C-21, C-29, F-4, F-5, F-15, F-16, F-117, H-1, H-53, H-60, OA/A-10, T-6, T-39, T-41, and U-2.	One Halon 1211 extinguisher per aircraft.
f. Alert Aircraft: (Except DC-9 Series used for medical evacuation, refer to entry 3h. or 3i. when passenger(s) are on board.) B-1, B-2, B-52, C-5, C-17, C-130, C-141, DC-9 Series, DC-10 Series, E-3, E-4, E-8, KC-135, T-43, VC-25, and B-747.	Two Halon 1211 extinguishers per aircraft.
14. Aircraft parked inside hangar that have been fully defueled and all tanks and fuel system have been drained and purged.	The Fire Protection Flight determines the type of extinguisher(s) required for the associated process hazards.

3.12 DISTANCE CRITERIA.

Use Table 3-2 to determine safe distances between parking areas and fueling operations.

Table 3-2. Distance Criteria Between Parking Areas and/or Fueling Operations (Distance in Feet)

	Aircraft Parking Areas/ Uninhabited Buildings	Taxiing Aircraft	Inhabited Buildings	Mass Refueling Unit Parking Area
Mass Refueling Unit Parking Area	100/50	50	100*	N/A
Hot Refueling	200**	50***	200**	200
Rapid Defueling	50	50	200****	200

NOTE

- For large aircraft (all bombers, all airliners, all transport aircraft carrying more than 20 passengers), the distance criteria is measured as the closest point between the aircraft FSSZ and building or facility involved. For small aircraft (fighters, helicopters, utility aircraft, and small transports carrying 20 or less passengers), the distance criteria is measured as the closest point between the aircraft and building or facility involved. In any case, a building or facility cannot be inside the FSSZ.
- Hardened Aircraft Shelters/Protective Aircraft Shelters are not considered to be either Inhabited or Uninhabited Buildings for the purpose or application of this table.

* For existing parking areas, the distance may be modified on the basis of local conditions, however, the separation distance shall not be reduced below 50 feet.

**For E-4B aircraft, the distance from the wingtip can be reduced to 100 feet.

***Part of an aircraft may pass within 50 feet of a hot refueling operation as long as the operating engine(s) of the taxiing aircraft do not penetrate the 50-foot criteria.

****When rapid defueling with an external hydraulic power cart (and no aircraft engine operating) this distance can be reduced to 100 feet.

CHAPTER 4
FLIGHT LINE SERVICING OPERATIONS

4.1 POWERED SUPPORT EQUIPMENT (SE).

4.1.1 Positioning and Operation of Support Equipment. To control, position, and operate powered and non-powered support equipment used for aircraft servicing, the following requirements apply:

a. All support equipment not required in servicing operations shall be shut down prior to the start of servicing. Unless required for servicing, support equipment shall not be parked under any part of an aircraft being serviced. Parking brakes shall be applied when support equipment is in position and, if necessary, because of ramp slope conditions, chocks will also be used. Chocks shall be used on wheeled support equipment that does not have operable parking brakes.

b. Operating powered support equipment shall be parked outside the fuel servicing safety zone of the aircraft being serviced and 10 feet from any aircraft not being serviced. Exception: During CSOs, powered support equipment, i.e., munitions loaders/jammers, may pass underneath aircraft fuel vent outlets but must not stop or be parked under the fuel vent outlets during fuel servicing portions of the CSOs. Wind direction, ramp slope, mechanical strain on cables or ducts, and location of the fuel source are also important considerations. Exhaust outlets shall not be pointed at the aircraft when starting powered support equipment. An operator shall remain in the vicinity of operating powered support equipment at all times.

WARNING

Avoid touching exhaust manifold if doubt exists as to temperature. Serious burns may result if the manifold is hot.

c. Support equipment shall not be refueled while operating, or when exhaust manifold/piping is hot (750 °F or more). Support equipment shall not be started when fuel vapors are noticeably present. Do not refuel support equipment directly from aircraft drain cocks.

4.1.2 Driving and Parking Fuel/Water Servicing Vehicle/Equipment. Fuel servicing vehicles will not be driven or parked closer than 25 feet from aircraft unless a spotter is used to direct the vehicle. (Exception: Fuel servicing vehicles being positioned for aircraft servicing may be driven under the horizontal stabilizers of B-1, C-5, C-17, C-130, C-141, E-4, VC-25, and Boeing 747 aircraft as long as: the vehicles stay on paved surfaces; maintain at least a ten foot clearance from any portion of the aircraft; and a spotter is used.) Special attention must be given to clearances between the fuel servicing vehicle and the aircraft cargo door when open and the ramp when lowered.) Under no circumstances will the vehicle be positioned closer than 10 feet from the aircraft. (Exception: A-10, C-5, C-17, C-130, C-135, E-4B, VC-25, Boeing 747, C-27, and U-2R aircraft only, the vehicle may be within 10 feet but no closer than four feet from the aircraft in any direction. For C-5, C-17, E-4B, VC-25, and 747 aircraft, the fuel truck may be positioned as far under the wing as necessary for the fuel hose to reach the aircraft.) Except during nose-in, nose-out or double-stuff conditions in a HAS/PAS, maintain a minimum of 5 feet between fuel servicing vehicles and any portion of the aircraft. (R-11 fuel servicing vehicles when used inside hardened aircraft shelters are exempt from the minimum 5 feet clearance requirements). Hydrant servicing vehicles and hydrant hose trucks with highlift platform servicing capability may be permitted under the wing of an aircraft, if this positioning is required to perform the fuel servicing operation. Always maintain a clear path from the aircraft for rapid evacuation of vehicles in an emergency situation.

WARNING

Where fully extended aircraft flaps could potentially interfere or minimize clearance with refueling equipment, ensure aircraft flaps are in the full upright position prior to positioning refueling equipment.

a. Avoid driving vehicles or equipment directly toward parked aircraft when within 25 feet since a brake failure could result in a collision. Approach the aircraft parallel to the wings (except in instances where single point location on the aircraft requires a different approach) and with the vehicle operator's side adjacent to the aircraft.

b. Stop the servicing equipment at least 25 feet from the aircraft, uphill if possible, and move into servicing position cautiously upon signal from directing personnel. If backing is absolutely necessary to approach an aircraft, post a spotter and place chocks to preclude the vehicle from striking the aircraft. Back very slowly so that the chocks can stop the vehicle in case of brake failure. When a series of aircraft in a row are to be refueled and the refueler moves forward along desig-

nated 10-foot minimum clearance markings painted on the ramp, the refueler may be moved from one aircraft to another without the use of a spotter as long as the clearance markings are visible to the refueler operator.

c. Do not drive or operate servicing vehicles in the servicing area if a fuel spill has occurred or if fuel is leaking from the aircraft. Do not use servicing vehicles, which have electrical system malfunctions.

d. Chocks may be constructed according to Commercial Item Description A-A-52475A (Chock, Wheel) or can be locally manufactured. Locally manufactured chocks can be constructed of wood and should have the following dimensions:

For single axle vehicles, 14 inches long, 3-1/2 inches high, and with a 5-1/2 inch base.

For tandem axle vehicles, 20 inches long, 5-1/2 inches high, and with a 7-1/2 inch base.

e. Fuel, oil, and water servicing vehicles need not be grounded. However, they must be chocked when the driver's seat is vacated.

4.2 AIRCRAFT REFUELING.

Fire and explosion hazards are always present during aircraft fuel servicing operations. Use of vehicle and equipment operational checklists is mandatory.

NOTE

- Refer to Table 3-1 for all fire protection equipment requirements.
- Do not position vehicles with the front of the vehicle facing toward any portion of the aircraft except for ARFF vehicles located in their designated standby position. A clear path shall be maintained at all times to permit rapid evacuation of servicing vehicles and personnel in the event of an emergency. Do not park in the front or rear of ARFF standby vehicles.

a. Ensure required fire protection is in place.

b. Unless specifically exempted elsewhere in this TO, personnel not required to service the aircraft shall leave the fuel servicing safety zone. The APU/GTC will not be used during fueling operations on aircraft not specifically listed in Paragraph 4.5.

c. Except when the equipment uses Power Takeoff (PTO) to drive the pump (HSV and HHT are exempt), turn off the ignition switch after the servicing vehicle or equipment is parked, brakes set, and before wheels are chocked. The fuel servicing operator is now prepared to assist in the aircraft fuel servicing operation.

WARNING

For over the wing/open port fuel servicing, always bond the nozzle to the aircraft before the fill cap is removed. This connection shall remain in place until after the tank cap is replaced. Failure to perform this procedure can cause a static spark at a tank fill opening.

d. Bond the fuel servicing vehicle and equipment to the aircraft.

WARNING

- With the SPR nozzle crank handle in the closed position, check the strainer coupling quick disconnect device for positive locking if equipped.
- Prior to pressurizing the hose, be sure the nozzle is securely locked to the aircraft by attempting to remove the nozzle with the nozzle crank handle in the open position. 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. On aircraft with Refueling Teams, the team member connecting the refueling receptacle will be responsible for testing the strainer quick disconnect locking device for positive engagement and assuring the refueling nozzle is securely locked.

e. For single point servicing, the fuel servicing supervisor will ensure the SPR nozzle is properly connected to the aircraft-refueling receptacle. For C-5 aircraft, the refueling equipment operator may perform these operations, to include monitoring the single point nozzle(s) during the fuel servicing, with installation commander approval. The 45-degree D-1 nozzle is acceptable for most SPR fuel servicing operations, especially for fuselage servicing. The straight throat D-2 nozzle is only for underwing fuel servicing applications and must not be used otherwise unless deemed mission essential. Mission essential determination shall be documented on the control log in the fuels automated system by the on-duty fuels controller. Inappropriate utilization of the single point nozzles can and has caused undue stress damage to aircraft single point receptacles, fuel spills, broken nozzles and components, and other safety related problems. The C-135 and F-15 series aircraft have angled SPRs, so they can be refueled/defueled with either the D-1 or D-2 nozzles. However, the straight throat D-2 nozzle is preferred for under-wing fuel servicing to minimize possible stress damage to the aircraft SPR adapter. The D-3

nozzles can be used on any SPR on any aircraft. Refer to Table 4-1 for a complete list of approved/authorized single point refueling nozzles.

NOTE

Crew ladders that do not present an interference problem or would not cause damage to the aircraft in case of strut deflation may remain installed on the aircraft during normal refueling.

f. Workstands, ladders, and any other equipment, not required for servicing, shall be kept clear of the aircraft.

g. Connections for any auxiliary equipment such as intercoms, auxiliary power unit, and portable refueling panels shall be completed before starting the fuel transfer operation. Do not disconnect this equipment while fuel servicing is in progress.

h. The electrical power cables shall be of sufficient length to permit parking of the power unit outside the FSSZ.

WARNING

During fuel servicing, fuel vapors are forced out of the vents by the incoming fuel. An explosive vapor-air mixture normally exists in the vicinity of the aircraft fuel vent. Special care must be taken that no active ignition source is in, or enters into, this area.

CAUTION

The fuel added during servicing may cause the aircraft to settle.

i. Service the aircraft as directed in MDS specific technical orders.

j. The fuel servicing operator will closely monitor the control panel meters and gauge system on vehicles and hose carts during the fueling operation and be prepared to shut down in case of a fuel leak or other malfunction.

CAUTION

The use of any means to defeat the deadman control installed on fuel servicing equipment is expressly prohibited.

k. For normal day-to-day fuel servicing, the servicing unit operator will hold the deadman control, unless aircraft checklists or operating procedures stipulate the aircraft refueling supervisor/SPR monitor will hold the deadman control valve.

l. When refueling by hydrant system, the fuels operator will hold the remote control switch or magnet switch lanyard throughout the refueling operation.

m. When aircraft fuel servicing is complete, a servicing crewmember shall close and disconnect the SPR nozzle.

n. A servicing crewmember will assist the fuels equipment operator in reeling and stowing the hose on the vehicle or equipment and/or disconnect and stow the hydrant hose.

CAUTION

Grounding/Bonding clamps/plugs shall not be allowed to drag across the ramp. Clamps/plugs shall be carried to reels on equipment.

o. The fuels equipment operator will disconnect and remove the bonding cables.

p. Use of the Hammonds Model HT-800-1L and 4T-4A injectors (and associated carts) are authorized for adding Fuel System Icing Inhibitors (FSII) and other fuel additives to aircraft during routine fueling operations.

q. Kamlock connectors must be secured with wire ties or plastic ties. Do not use adhesive tape, as fuel might dissolve the adhesive.

r. Some aircraft use their fuel as a coolant, so the aircraft fuel temperatures can be well over 100 °F. Exercise caution when refueling or defueling these aircraft. Avoid the areas near the fuel vent outlets and be prepared to shield personnel from fuel spills and sprays. It is highly recommended that no fuel servicing operations take place with fuel temperatures exceeding 130 °F; higher fuel temperatures can damage fuel servicing equipment and injure personnel.

s. When a high lift truck is used for refueling, once the nozzles are securely connected to the aircraft, the truck operator can descend from the high lift platform and control the operation from the ground. However, if the aircraft refueling point has fuel tank quantity gauges, the operator must remain where he/she can monitor those gauges.

Table 4-1. Approved/Authorized Single Point Refueling (SPR) Nozzles, Vacuum Breaks, and Dry Break Couplers

NSN	Manufacturer	Type	Part No.	Note	Hot Refueling	CSO	Concurrent Servicing	Swivel Feature	45 Deg Throat	Straight Throat
4930-00-544-3713	CARTER	D-1	6902	1		X	X	NO	X	
4930-00-310-4858	CARTER	D-1	61429AGH	2, 3	X	X	X	YES	X	
4930-01-385-8946	CARTER	D-1	64349H		X	X	X	YES	X	
4930-00-310-4858	THIEM/WHITTAKER	D-1	F1116ES		X	X	X	YES	X	
4930-01-484-5919	CARTER	D-1	64201H		X	X		YES	X	
4930-01-318-1479	CARTER	D-2	61429AGJ/ 64349J	2	X	X	X	YES		X
	CARTER	D-2	64201J		X	X		YES		X
4930-01-385-8924	CARTER	D-2	64349J		X	X	X	YES		X
4930-01-250-7482	THIEM/WHITTAKER	D-2	F116KN		X	X	X	NO		X
4930-01-032-0236	CARTER	D-2	60427WX		X	X	X	NO		X
NOT ASSIGNED	THIEM/WHITTAKER	D-2	F1116ER		X	X	X	YES		X
4930-00-117-4726	WIGGINS	CCR	CCN101/14		X					
4930-01-363-6449	CARTER	CCR	64017		X					
4930-01-040-7618	THIEM/WHITTAKER	Bottom Loading	F211C	4						
NOT ASSIGNED	CARTER	Bottom Loading	614458L	4						
4820-01-013-4272	AEROQUIP	VAC BRK	AE98706E	5	X	X	X			
4820-01-345-0629	CARTER VAC	44595 BRK		5	X	X	X			
4820-01-059-9417	CARTER VAC	41599 BRK		6	X	X	X			
4730-01-366-9406	CARTER	Dry Break	61154	7	X	X	X			
SEE NOTE	AEROQUIP	Dry Break	AE985()	8	X	X	X			
4930-01-534-0950	JC CARTER	D-3	47566	Inlet	X	X	X	YES	X	X
4930-01-544-1945	JC CARTER	D-3	64201N		X	X	X	YES	X	X
NOT ASSIGNED	THIEM/WHITTAKER	Dry Break	F596()	9	X	X	X			
	JC CARTER	Ball Valve	64015		X	X	X			
	JC CARTER	Hose Extension	64207		X	X	X			
4930-01-483-8060	CLA-VAL	D-1/2	341GF		X	X	X	YES	X	X

Table 4-1. Approved/Authorized Single Point Refueling (SPR) Nozzles, Vacuum Breaks, and Dry Break Couplers - Continued

NSN	Manufacturer	Type	Part No.	Note	Hot Refueling	CSO	Concurrent Servicing	Swivel Feature	45 Deg Throat	Straight Throat
	CLA-VAL		342GF		X	X	X			X
	CLA-VAL		344GF		X	X	X			
	CLA-VAL	Dry Break	C-BV-65/3F		X	X	X			
	CLA-VAL	Dry Break	C-GE-65F		X	X	X			
4930-01-544-1949	JC CARTER	D-3	64349N		X	X	X			
NOT ASSIGNED	CLA-VAL	D-3	341GF (205195-01K)		X	X	X			
NOT ASSIGNED	CLA-VAL	Ball Valve	E349GF E349GF-1		X	X	X			
NOT ASSIGNED	CLA-VAL	Nozzle	E347		X	X	X			

[1] Restricted from hot refueling unless retrofitted with crank handle PN 210089 (ZA-12 Alloy) (NSN 5340-01-344-5505).

[2] All parts on the Carter 61429AGH, AHL, and AGJ are interchangeable.

[3] The Carter 61429AGH and 61429AHL are the same except the 61429AHL has short handles. No new 61429AHL nozzles will be procured for USAF use.

[4] Used on bottom loading fillstands. Can be utilized as hydrant to hose cart adapter on hydrant systems equipped with 2 1/2-inch bayonet adapters.

[5] Limited to Carter PN 6902 SPR nozzle (AN fitting).

[6] All other approved SPR nozzles (NPT fitting).

[7] Couplers with 40 mesh screen strainers are capable of defueling at rates in excess of 400 gallons per minute without damage to the screen and therefore the screen need not be removed for defueling.

[8] PN AE985-17U, NSN 4730-01-015-9209, (3 inch female coupler half); PN AE985-17V, NSN 4730-01-034-5391, (4 inch female coupler half); and PN AE985-16U, NSN 4730-01-015-9208, (3 or 4 inch male coupler half) requires the use of a 100 mesh screen strainer, NSN 4730-00-432-1223, which will collapse when defueling in excess of 200 gallons per minute, therefore the screen must be removed during high flow rate defuels to avoid damage to the screen.

[9] Available in 2, 2 1/2 and 3 inch sizes.

4.3 MULTIPLE SOURCE REFUELING.

Normally, only one refueling truck at a time is used to service Air Force aircraft. However, there are situations when multitruck or truck and hydrant servicing are concurrently accomplished. Multiple source refueling is prohibited on medical evacuation aircraft when patients are on board or when patients are enplaning or deplaning. Multiple refueling source restrictions do not apply to a single hydrant truck having two refueling hoses.

4.3.1 R-11 Fuel Tank Trucks.

WARNING

- Multiple fuel source servicing adds an additional risk due to the increased complexity of the operation and additional personnel and equipment required to perform the function.
- Refueling operators must continuously monitor refueling flow meters for correct indication of fuel flow. If back flow is detected, immediately stop all refueling operations. In addition, if using 1st or 2nd generation Kovatch R-11s, operator must monitor the tank wet/dry sensor indicator lights on the main control panel. If the wet (RED) indicator light illuminates during operation, the operator will immediately stop refuel (releasing deadman).
- Refueling operators shall ensure the Defuel Override Control Valve is in the off position and locked (Oshkosh R-11) and the Red Protective Cover is closed (1st and 2nd generation Kovatch R-11) prior to starting any fuel operations. Failure to do so could result in a fuel spill.

CAUTION

- When dispensing fuel from multiple vehicles and hydrants, ensure that the aircraft refueling isolation valve is in the refuel/defuel or closed position.
- For multiple source refueling, assure both trucks are in same operational mode prior to commencing fueling operations and ensure applicable refueler TO guidelines are strictly followed.

R-11 fuel tank trucks may be used to multiple source refuel any aircraft with more than one single point refueling receptacle. Other multiple truck or simultaneous truck and hydrant refueling can be accomplished on Airbus A300/A310, C-5, C-17, C-18/B-707, C-137, KC-135/T, E-4B, B-747, B-777, VC-25, DC-8, DC-10, KC-10, MD-11, and L-1011 aircraft. However, for C-5, C-18/B-707, and L-1011 aircraft, multiple sources, with the exception of R-11 fuel tank trucks, cannot be used to simultaneously refuel on the same side or wing of these aircraft. The operators of all Kovatch R-11 refuelers shall monitor the wet/dry (red/green) defuel lights on the main control panel during all B-1 and B-2 weapon system multi-source fuel operations for evidence of possible backflow/overfill conditions. Multiple source refueling also requires that:

a. Intercom contact is maintained between the fuel servicing supervisor and the fuel panel operator(s) at all times during servicing.

b. The applicable aircraft -2 technical orders contain specific instructions and checklists for accomplishing multiple truck or simultaneous truck and hydrant refueling procedures.

4.3.2 Multiple Refueling Trucks Locations. When multiple refueling trucks are located on the same side or wing of an aircraft, the vehicles must be positioned at the aircraft prior to initiating any fuel flow and remain positioned and bonded until fuel flow is terminated on all trucks on that side of the aircraft.

4.3.3 Multiple Source Refueling Authorization. Multiple source refueling for aircraft not listed above is authorized when the refueling sources are capable of preventing fuel from passing from one truck or hydrant through an aircraft and back onto another truck.

4.4 AIRCRAFT DEFUELING.

WARNING

Do not exceed a defueling rate of 175 GPM when using an R-11 fuel truck. Defuel flow rates exceeding 175 GPM may cause fuel to go through the bypass system and could result in overfilling the unit.

Defueling is the movement of fuel from an aircraft fuel tank to any external, approved container or system through the SPR receptacle to exclude the draining of small amounts of residual fuel from externally mounted components (i.e. fuel pumps, valves, engines) as authorized per TO 1-1-3, page 2-8 paragraph 2.7.9 and removal of fuel or other liquids from cells or tanks via the aircraft fuel system drains. Procedures listed in Paragraph 4.2 concerning aircraft refueling are ap-

plicable to aircraft defueling, using vehicles/equipment or hydrant fueling systems. The following additional procedures shall be used when defueling an aircraft:

a. Prior to defueling, maintenance personnel shall drain all water from aircraft sumps. If contamination is suspected, retain a fuel sample for visual examination by fuel servicing personnel.

b. Determine the fuel grade by consulting the aircraft AFTO 781 series forms/record. Pay particular attention to aircraft which have undergone fuel cell maintenance where leak detection dye could have been used, or for aircraft which normally use a certain grade of fuel, but which were last serviced with an alternate fuel. If in doubt, or if contamination is suspected, request a fuel test.

NOTE

Routine defueling for weight and balance, fuel load change, or maintenance, does not ordinarily require special sampling and testing.

c. Do not pressurize the vehicle or equipment hoses with the single point nozzle open and the aircraft valve in defueling position.

NOTE

Defuel suction hose extension (Pigtail) does not require bonding.

d. During defueling with the Condiesel (1981) R-9, Kovatch R-9, and Oshkosh R-11 fuel servicing vehicles verify that the high level shutoff is operational. The Kovatch R-11 has an electronic high level shutoff and does not require pretest. For all other units ensure an individual is on top of the unit to observe fuel level and signal the pump operator when the unit is full.

e. The electrical power cables shall be of sufficient length to permit parking of the power unit at least 50 feet away from fuel servicing vehicles and equipment, and outside of the fuel servicing safety zone and preferably upwind.

CAUTION

Fuel being drained from aircraft sumps into containers or bowsers should not be allowed to free-fall.

f. Fuel that cannot be evacuated by normal truck or hydrant defueling operations may be drained into a rubber pail (NSN 7240-01-150-0716 only), clean metal container or bowser. Mark the container with the grade of the product being collected and restrict to this use only. Bond metal container or bowser to aircraft during draining operations.

g. All fuel drained from aircraft sumps shall be recovered by aircraft maintenance, sampled and visual analysis performed by qualified fuels personnel. Recovery will be in accordance with TO 42B-1-23 procedures.

h. An ARFF vehicle must be on the scene when any of the following conditions exist:

(1) Defueling an aircraft, which has a fuel leak in the system or under emergency conditions resulting from damage to the aircraft from fire or impact.

(2) Defueling under conditions requiring drainage of fuel into open containers or drums (other than draining residual fuel into an approved safety container or bowser following a defuel operation).

(3) Defueling aircraft at a location where established safety distance criteria cannot be met.

i. The C-17, VC-25, L-1011, and DC-8 aircraft can undergo multiple source defueling, i.e., defueling into two similar trucks.

4.5 APU/GTC USE DURING REFUELING AND DEFUELING.

The aircraft APU/GTC may be used to supply electrical power for single point fuel servicing and defueling of Airbus A300/310, E-4B/B-747, B-777, VC-25A, E-3, E-6A, C-130, C-141, C-5 (both APUs), C/DC-9, C-20, C-22/B-727, C-27, F-22, T-43, P-3, CH-53, KC/DC-10, C-137/C-18/B-707, B-737/757/767, C-17A, DC-8, L-100, L-188, L-1011, MD-11, MD-81/82/83/88/90, KC-135R/T, E-8C, X-32, X-35, V-22, C-135C (Serial No. 61-2669), B-1B (Left APU only), B-2 (Right APU only), C-17, C-38, C-32, C-40, CH-47 and AH-64 aircraft, and contractor commercial aircraft when this procedure is approved in the carrier's manual. The APU/GTC will not be used during fueling operations on aircraft not specifically listed above. The following precautions apply during this operation:

a. If the aircraft is not equipped with an integral APU fire fighting system, one individual shall remain outside the aircraft within 20 feet of the APU/GTC compartment exhaust with a 150-pound Halon 1211 fire extinguisher. (Refer to Table 3-1.)

b. One person shall remain located at the APU/GTC controls at all times during fuel servicing operations. The

APU controls can be either in the cockpit or on an APU ground control panel. A person is not needed in the cockpit if the APU:

(1) Has automatic shutdown capability for an overheat or fire condition.

(2) Has an on-board fire extinguishing system.

(3) Has an audible fire alarm that can be heard outside the aircraft.

(4) Ground control panel has the capability to manually shut down the APU and discharge the fire extinguishing system. For B-1B aircraft, the APU/panel operator shall be positioned to ensure immediate access to the APU controls and fire fighting agent discharge switch.

c. Cockpit personnel, CSS or fuel servicing supervisor, and the servicing crew at the SPR panel shall be in constant voice contact to ensure shutdown of the APU/GTC in case of an emergency and to ensure discharge of the fire-extinguishing agent in case of an APU/GTC fire.

d. Except for C-5 and C-17 aircraft, fuel servicing sources will not be located within 50 feet of any operating APU/GTC.

e. The APU/GTC must be started and running in a stable condition prior to pressurizing the refueling hose or pantograph.

4.6 INITIAL FILLING OPERATIONS OF AIRCRAFT WITH FOAM FILLED FUEL TANKS.

Numerous internal flash fires have occurred within aircraft blue foam filled tanks during refueling. In some cases, there were no audible sounds or immediate indications that an incident had occurred. These incidents are mainly due to electrostatic ignition of the volatile fuel/air mixture during initial filling operation. Fuel flowing through reticulated urethane foam at high velocities can generate sufficient electrostatic charge to produce incendiary spark discharges within aircraft fuel tanks. A fuel conductivity additive is now added to all JP-4 and JP-8 fuels to minimize the generation of static charges. However, initial filling must still be accomplished at a reduced flow rate when fueling new or recently repaired aircraft bladder tanks that are in a vapor-free condition. Refer to the applicable -2 series technical orders for more complete information.

NOTE

The fuel servicing supervisor shall notify the refueling operator when reduced fuel flow is required.

a. Reduced flow rate refueling procedures will be used when fuel servicing vehicles are the pumping source. When installed hydrant systems are used, only one hydrant pump will be activated. These procedures shall be followed until the tanks are full or at the level directed by the mission.

b. These procedures apply to all Air Force owned aircraft and any non-Air Force aircraft, meeting the above fuel cell/tank conditions, being refueled on an Air Force base.

4.7 FILLING FUEL SERVICING VEHICLES FROM HYDRANT SYSTEMS.

Refueling units are sometimes filled on the flight line. This is accomplished by positioning a hose cart or hydrant servicing vehicle on an available hydrant outlet and assigning a qualified fuel specialist to fill refueling units. The distance criteria established for aircraft refueling in Table 3-2 apply. Procedures established in TO 37A2-2-4-1CL-1, Appendix B, or 36A12-13-31-1CL-1 shall be followed.

4.8 SERVICING IN AIRCRAFT ALERT, HARDENED/PROTECTIVE AIRCRAFT SHELTERS (HAS/PAS), OR FLOW THROUGH REVETMENTS (FTRS).

WARNING

For emergency situations, immediately accomplish the following. Cease all operations. Notify the fire department. Use available fire extinguishers when needed. Evacuate nonessential personnel from the area. Open Hardened/Protective Aircraft Shelter doors.

When servicing in aircraft alert, Hardened/Protective aircraft shelters, or FTRs, the following applies:

a. Aircraft may utilize CSO procedures as approved by SSEA for simultaneous operations. MDS specific technical order procedures for aircraft reconfiguration, servicing, inspections, and munitions loading/unloading, will be followed. Only those activities specifically authorized in aircraft technical orders will be performed in conjunction with aircraft servicing. Servicing operations inside shelters/FTRs present a greater degree of risk than the same operations conducted outside on open ramp.

NOTE

The adjacent aircraft parking criteria (Paragraph 3.8) does not apply to FTR since the revetment wall minimizes the probability of spreading of fire or explosion.

b. The fuel servicing safety zone criteria shall be complied with. Refueling will not start until all nonessential personnel and equipment have been removed from

the area. During servicing operations, restrictions will be placed on the entry of nonessential personnel or equipment into the servicing area. During CSOs powered support equipment, i.e., munitions loaders/jammers, may pass underneath aircraft fuel vent outlets but must not stop or be parked under the fuel vent outlets during fuel servicing portions of CSOs.

c. A communications system or portable radio must be available and operational. Refer to Chapter 3 for servicing constraints.

d. The fuel servicing vehicle will be positioned outside the shelter and at the maximum hose length from the aircraft unless otherwise specified in this technical order. Fire protection equipment requirements shall be available as specified in Table 3-1. Operations will

cease during any fuel spill and will not resume until the spill has been removed or neutralized and the area has been determined safe.

e. All powered vehicles or equipment not involved in the servicing operation shall be shut down and parked in an area that will not obstruct the operation. When powered support equipment is required for the fuel servicing operations, the equipment should be positioned outside the shelter when possible. If the equipment cannot be positioned outside, it may be positioned inside, however, all aircraft entry doors must remain open.

f. Electrical systems shall be Class I Division 1 (Zone 1) below the floor and Class I Division 2 (Zone 2) above the floor to height of the highest door or roof which ever is lower. In the case of existing shelters and FTRs that do not meet these criteria, required shelter/FTR electrical systems must be activated prior to refuel/defuel operations and left unchanged. Ceiling lights may be on, but all other nonessential electrical systems must be off. Electrical convenience outlets (wall socket plugs) will not be used during fuel servicing operations.

g. The fueling supervisor shall be prepared for immediate removal of the refueling equipment where rapid evacuation and/or alert reaction may be required.

CAUTION

Refueler vehicle engine should not be operated more than 20 minutes when aircraft entry doors are closed. When aircraft entry doors are closed, the shelter aircraft can be refueled inside a completely closed shelter. Crew members conducting in-shelter refueling with shelter doors completely closed should be limited to four per duty day and should have at least a sixty minute period of low or no fuel vapor exposure between refueling aircraft in a closed shelter.

h. Shelter doors will remain open during fuel servicing. However, HAS/PAS doors can be closed only when all of the following apply:

(1) Exercise/contingency/wartime situation.

(2) Aircraft engines not running (cold refuel operation).

(3) Fuel servicing equipment is inside the shelter.

i. Fuel servicing vehicles will not be backed into shelters until a chock is placed to stop the vehicle in case of brake failure and a spotter is in position to direct movement.

j. Aircrew members may remain in shelters/FTRs during CSOs.

4.9 UNIQUE REQUIREMENTS WHEN SERVICING IN HARDENED/PROTECTIVE AIRCRAFT SHELTERS (HAS/PAS).

a. If a HAS/PAS does not meet HQ USAF approved electrical standards of the National Electrical Code for Class I, Division 2 (Zone 2) hazardous locations, the following conditions/restrictions apply:

(1) The electrical power and wall/underling lights may be energized (left on) in second and third generation HAS/PAS when aircraft are placed on shelter centerline in either a nose-in or nose-out configuration. Electrical circuitry and switches shall be placed in their required operational positions and no changes made during fuel servicing operations.

(2) For first and modified first generation HAS/PAS with aircraft placed on shelter centerline in either a nose-in or nose-out configuration, all electrical power that can reasonably be de-energized as defined by MAJCOM operating procedures shall be turned off. Wall/under-wing lights may be energized (left on) if the MAJCOM is willing to accept the increase in risk by having aircraft fuel vent outlets in close proximity to the non-hazardous area electrical distribution system and potential ignition source. Positioning of electrical circuits and switches shall not be changed during fuel servicing operations.

(3) In second or third generation HAS/PAS, the placement of aircraft off centerline to support double-stuff conditions increases the level of risk for fuel servicing operations to the approximate equivalency of operations in a first or modified first generation HAS/PAS and would require the same restrictions.

b. Fuel servicing vehicles may be positioned inside or outside of shelters. When positioned inside they will be backed into the shelter on the right or left side of the aircraft. Except during nose-in or double-stuff conditions, the nearest part of the fuel servicing vehicle must not be closer than 3 feet from the shelter wall or door. (R-11 fuel servicing vehicles are exempt from the minimum 3 feet clearance requirements for nose-in, nose-out, and double-stuff conditions.) Whether one or more aircraft are parked within a HAS/PAS, the FSSZ must be strictly enforced during servicing operations.

4.10 FOUR BASIC TYPES OF HAS/PAS ARE SHOWN IN FIGURE 4-1.

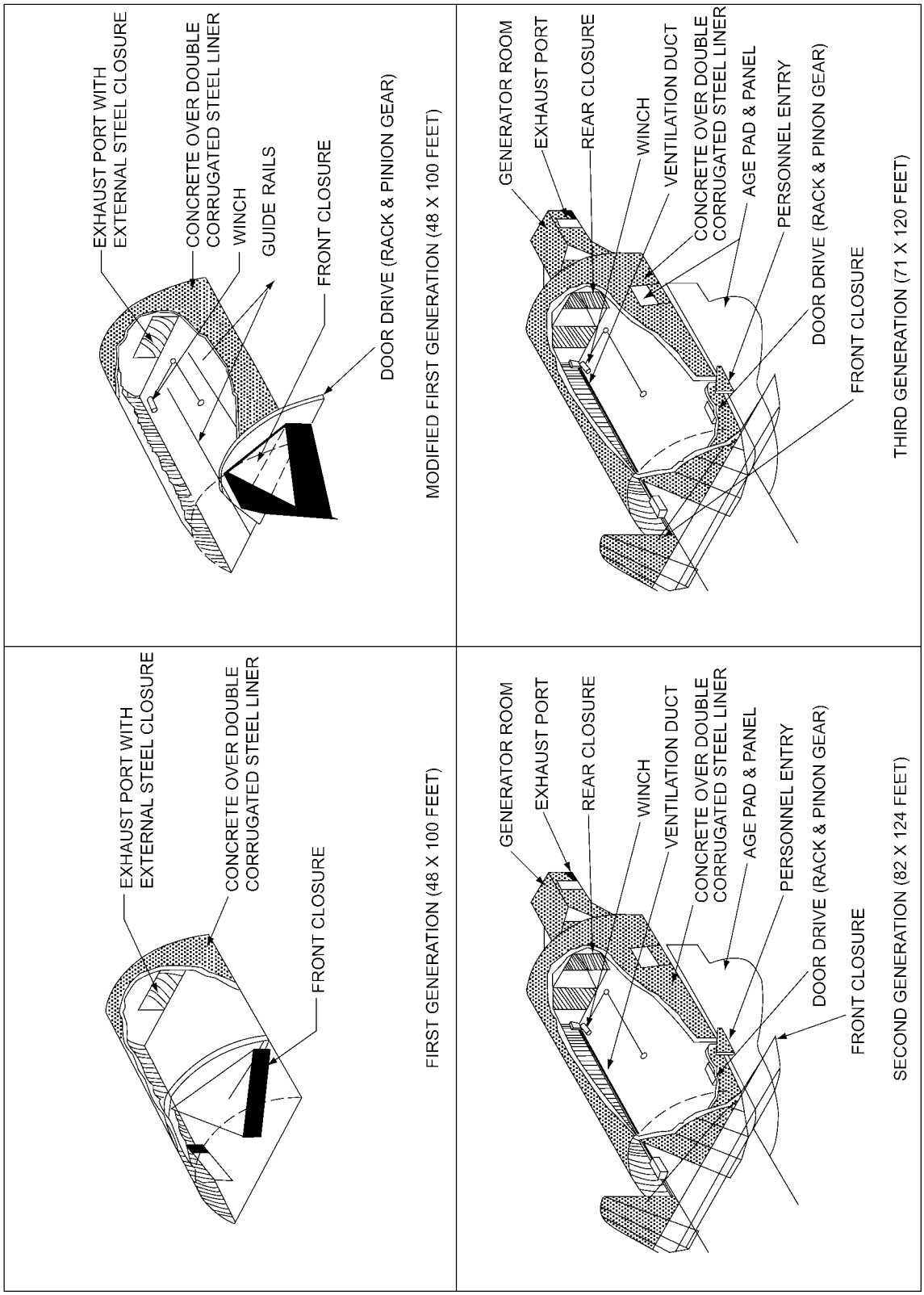

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Figure 4-1. Hardened/Protective Aircraft Shelter Examples

4.11 AIRCRAFT FUEL SERVICING IN TYPE A/F 37T10/11 HUSH HOUSES (ENCLOSED AIRCRAFT/ ENGINE NOISE SUPPRESSOR SYSTEMS).

NOTE

- Aircraft will be fully fuel serviced before being placed inside hush houses for engine test runs.
- These procedures are provided ONLY to be used on an exception basis, i.e., only after a fully fuel serviced aircraft has undergone engine test runs and was not able to be completed because of fuel depletion. These procedures are provided only for the purpose of alleviating the necessity to tow an aircraft 50 feet outside a hush house to accomplish fuel servicing before continuing the engine test runs. These procedures are NEVER to be used just for convenience's sake.
- Fuel servicing vehicles may be positioned outside or inside of hush houses for fuel servicing operations. R-9 and R-11 fuel servicing vehicles shall only be backed into hush houses using a spotter and a pre-positioned chock. Place the fuel servicing vehicle parallel to the aircraft fuselage at approximately the one to two o'clock or the ten to eleven o'clock position from the aircraft's cockpit (depending upon the location of the aircraft refueling receptacle).

In the event fuel servicing of an aircraft is required while located in a Type A/F 37T10 or 11 Hush House, the following procedures will apply:

a. All other operations in hush house will cease during the fuel servicing operation.

b. All powered vehicles or equipment not involved in the servicing operation shall be shut down and parked in an area that will not obstruct the operation. When powered support equipment is required for the fuel servicing operations, the equipment should be positioned outside the shelter when possible. If the equipment cannot be positioned outside, it may be positioned inside. All support equipment normally used in hush house can remain in place provided electrical power is turned "OFF" and secured.

c. All personnel doors located on control room side of hush house will be closed. All other doors will be "FULLY OPEN" during fuel servicing operations.

d. All floor drains will be unobstructed.

e. Standby water flushing hoses will be readily available and maintained in good serviceable condition.

f. All electrical power will be turned "OFF" and secured to prevent activation during fuel servicing operations in hush houses manufactured by the following companies and having the following serial numbers:

(1) Aero Systems Engineering - Serial Numbers 001 through 023.

(2) Industrial Acoustics Corporation - Serial Numbers 201 through 207.

(3) Cullum Detuners Limited - Serial Numbers 301 through 313.

g. The following hush houses were designed and installed with all electrical conduit and equipment in the interior of the hush house test bay and equipment room to meet the requirements of the National Electrical Code for Class I, Division 1 (Zone 1) hazardous locations up to a height of 4 feet and Class I, Division 2 (Zone 2) hazardous locations from 4 feet up to a height of 12 feet. Electrical power does not need to be turned "OFF" during fuel servicing operations in these following hush houses, if being maintained according to the design specifications as listed above when manufactured by the following companies and having the following serial numbers:

(1) Environmental Elements Corporation - Serial Numbers 101 through 199 and 501 and 502.

(2) Industrial Acoustics Corporation - Serial Numbers 208 through 299.

4.12 FUEL SERVICING EXPLOSIVES-LOADED AIRCRAFT.

An aircraft is considered "explosives-loaded" when munitions or explosives are carried either internally or externally (including nuclear weapons). The term does not include explosive components of aircrew escape systems or pyrotechnics installed in survival and rescue kits and other components identified in TO 11A-1-33.

a. During initial generation an aircraft should normally be refueled before being loaded with either nuclear or nonnuclear munitions to reduce the severity of a mishap.

b. Fighter or bomber explosives-loaded aircraft returning from a mission may be refueled at locations meeting acceptable quantity-distance (Q-D) criteria when the munitions aboard are SAFED according to the specific aircraft -33-1-2 munitions loading manual. This also applies to cargo aircraft with explosive countermeasures systems (chaff and flare dispensers).

c. Cargo aircraft loaded with transportation-configured explosives may be refueled at aircraft explosives cargo parking areas, commonly called hot cargo pads.

d. Fighter or bomber nonnuclear explosives-loaded aircraft may be hot refueled when authorized in Table 6-1 and the munitions aboard are SAFED according to the specific aircraft -33-1-2 munitions loading manual.

4.13 FUEL SYSTEM MAINTENANCE FACILITIES.

Aircraft fuel servicing is permitted in fuel system maintenance facilities (fuel cell) complying with the facility requirements of TO 1-1-3. During fuel servicing, the facility must have a forced air ventilation system in operation, use a means of collecting fuel vapors from the aircraft vent outlets, or must have its doors open to provide adequate ventilation. Other aircraft can be present in a fuel call facility while an aircraft is being refueled, but only one aircraft can be refueled at a time.

4.14 FUEL SERVICING IN HANGARS AND OTHER FACILITIES.

NOTE

Aircraft can undergo fuel servicing in sun shades and sun shelters (e.g., Big Top, Agate, etc.) if the shades/shelters have no electrical provisions/equipment. If the shades/shelters have electrical provisions/equipment, they must meet National Electrical Code (NEC) Class I, Division 2 requirements or be completely de-energized prior to fuel servicing. (Centralized Aircraft Support Equipment may remain energized, but electrical switches must not be operated.) A separate SSEA is not required for sun shades and sun shelters.

Aircraft will not be fueled or defueled inside any hangar other than those facilities approved through a System Safety Engineering Analysis (SSEA). Shelters, FTRs and hush houses are addressed separately in this TO. A “universal SSEA” conducted by AFMC/SES in August 1996 determined that aircraft fuel servicing operations can be conducted in hangars and similar facilities as long as the facilities have the following provisions in good working order:

a. The facility is separated from other maintenance facilities as a separate building, or has masonry separating walls of not less than one hour of fire resistive construction and automatic opening protection of not less than 45 minutes.

b. The facility has a ventilation system capable of removing accumulations of fuel vapors during normal servicing. Personnel must not be exposed to fuel vapors beyond maximum exposure limits. (There are no established ventilation requirements from a fuel vapor ignition standpoint.) Individual suction devices located at the aircraft fuel vent outlets are desired, but are not required.

c. The facility must have a drainage system capable of handling and removing a fuel spill of at least 300 gallons.

d. The facility must have an installed automatic foamwater fire suppression system.

e. The facility electrical provisions must be designed for Class I, Division 1 (Zone 1), hazardous locations below floor/grade level.

f. Electrical equipment in the aircraft servicing area above the floor up to the height of the highest hangar door must satisfy NEC criteria for Class I, Division 2 locations.

g. A separate tabletop SSEA is required for servicing with low flash point fuels (JP-4, JET B, AVGAS, and MOGAS). As a minimum, Class I, Division 2 (Zone 2), electrical provisions will be required from the floor/grade level up to the facility ceiling lights.

h. Other aircraft cannot be inside the facility at the same time. Support equipment will not be powered unless it is essential for the fuel servicing operation. Nonessential personnel will be removed from the facility.

i. The fuel source (e.g., truck, hose cart) can be inside the facility but must use a deadman control unit. The aircraft fuel vent outlets must be continuously visually monitored during fuel servicing.

j. There are no additional restrictions for munitions-loaded aircraft.

NOTE

If a facility does not meet all of the above requirements, fuel servicing cannot be conducted unless a separate SSEA is accomplished for that facility. Table 4-2 lists specific hangars and other facilities that have been approved for aircraft fuel servicing via individual SSEAs.

Table 4-2. Specifically Approved Hangars and Other Facilities

Location	Facility	Date
Whiteman AFB, MO	B-2 Maintenance Docks	July 1988
Elmendorf AFB, AK	Hangar 17	May 1996
Great Falls, MT	Bldg 38 (Montana ANG)	August 1996
Eielson AFB, AK	Bldgs 1277, 1288, 1335, and 1338	August 1997
Hancock Field ANGB, NY	New Aircraft Weather Shelters	December 2000
Fargo AFB, ND	Temporary A/C Alert Shelters	April 2002
Hill AFB, UT	Big Top Shelters	February 2002
Travis AFB, CA	Big Top Shelters	July 2002
Edwards AFB, CA	F-22 Sun Shelters	October 2003
Davis Monthan AFB, AZ	Bldg 128	November 2003
Fort Wayne AGNB, IN	122FW Alert Systems	December 2003
Davis Monthan	Caltex Model FL 6060 Shelters	March 2005
Indian Springs AFB, NV	Big Top Shelters	April 2005
Balad, IR	Big Top Shelters	April 2005
Hill AFB, UT	Agate Metal Shelters	September 2005
Hill AFB, UT	Snow Shelters with Lights	December 2006
Vance AFB, CA	Sun Shades	December 2009

4.15 OXYGEN SERVICING.

The Air Force uses several grades of oxygen, based on its purity, moisture content and whether or not it is in liquid or gaseous forms. Type II oxygen is supplied for aircrew use. Quality control procedures are outlined in TO 42B6-1-1.

a. Gaseous oxygen (O_2) is a colorless, odorless, tasteless gas, slightly heavier than air. It is not flammable; however, it will support the rapid combustion of most materials. It reacts violently with petroleum products such as jet fuel and lubricants if an energy source such as a fire or spark from static electricity is present. When oxygen combines with fuels such as hydrazine there may be a hypergolic reaction (no heat necessary, and will spontaneously ignite). Gaseous oxygen must therefore be considered dangerous.

b. Liquid oxygen (LOX) is a pale blue liquid, which exists in the liquid state only at an extremely low temperature (-182.5 °C or -297 °F). It is not flammable; however, it will support the rapid combustion of most materials. If an energy source is present, it reacts violently with petroleum products such as jet fuel and lubricants. Liquid oxygen must therefore be considered dangerous.

c. Gaseous oxygen carts having cylinders installed on them will be considered in storage when cart is parked and not in use, and shall fall under the same requirements as stated in TO 42B5-1-2. If stored in the open, they must be protected from extreme weather conditions in accordance with TO 42B5-1-2. Oxygen servicing equipment shall be kept clean and free of moisture, oil, and grease at all times. Use only approved anti-seize tape for oxygen servicing fittings because of the temperatures, pressures, and fire hazards involved. Do not park oxygen carts in areas that are sodded, grassy, or asphalt covered. (Exception: LOX carts may be temporarily parked on asphalt, provided that drip pans, used exclusively for LOX servicing, are placed under the overflow vent of the cart.) Do not park LOX carts containing LOX in hangars, nose docks, or other buildings unless specifically designed or modified and set up for the storage and/or maintenance of such equipment. The following distance criteria for the parking or storing of LOX carts containing LOX and oxygen bottle carts containing gaseous oxygen applies:

(1) 25 feet from any structures having fire resistant or non-combustible exterior walls or with automatic fire extinguishing systems.

(2) 50 feet from any combustible structure or sources of ignition, such as heavy traffic areas, areas where equipment is in operation and smoking areas.

(3) 25 feet from parked aircraft and 25 feet from FSSZs.

(4) Maintain the liquid oxygen servicing safety zone (Paragraph 1.2.30).

CAUTION

Grounding/Bonding clamps/plugs shall not be allowed to drag across the ramp. Clamps/plugs shall be carried to reels on equipment.

NOTE

LOX carts shall be parked with the vent valve open and transported with the vent valve closed. LOX and gaseous oxygen carts need not be grounded.

d. The following general guidance applies to both gaseous and liquid oxygen servicing. Specific information concerning gaseous and liquid oxygen servicing is addressed in the following paragraphs.

WARNING

Do not allow oxygen to contact petroleum products as fire/explosion may result.

(1) Those persons not directly involved in oxygen servicing operations shall stay outside the 20-foot radius of the liquid oxygen servicing safety zone. Cellular phones and hand-held radios or any transmitting devices will not be used and will be turned off within 50 feet of the servicing area. Servicing personnel will ensure that their hands, feet, clothing, etc., are clean and free of petroleum base products. In addition, servicing personnel shall wear Personal Protective Equipment (PPE) required for either gaseous or liquid oxygen servicing.

(2) Do not commence oxygen servicing if aircraft electrical systems are energized within 25 feet of the servicing operation (except those required for servicing). In addition, do not perform oxygen servicing concurrent with fuel, oil, water-alcohol, hydraulic fluid, environmental fluid or hydrazine servicing or maintenance on systems containing these hydrocarbon products. Oxygen servicing connectors must be examined prior to servicing and any traces of petroleum products removed prior to servicing operations.

(3) Only qualified personnel shall operate oxygen equipment or service aircraft systems.

(4) The mobile servicing unit or bottles used to service aircraft or components shall be carefully positioned and shall not be left unattended after hook-up.

(5) Do not service/purge aircraft with oxygen within 50 feet of taxiing aircraft (measured from the wing tip or closest point of taxiing aircraft to the pressurized oxygen servicing equipment). Aircraft parked adjacent to an aircraft being oxygen serviced shall not have engine runs performed unless the closest point of the adjacent aircraft is more than 50 feet from the pressurized oxygen servicing equipment.

(6) Aircraft oxygen systems (both gaseous and liquid) shall be emptied/drained prior to entering a major maintenance cycle at either an Air Logistics Center, Contract Repair Facility, or Contract/Depot Field Team location.

(7) Only night vision goggles and intrinsically safe devices can be operated in the oxygen servicing safety zone.

(8) Ground and bond oxygen servicing equipment according to TO 15X-1-1.

4.16 GASEOUS OXYGEN SERVICING.

WARNING

- Do not direct gaseous oxygen toward body or clothing. Serious injury or death may result from the high energy of compressed gas and/or fire because of the rapid burning or explosive tendencies of organic materials in the presence of pure oxygen.
- When servicing low-pressure oxygen systems, the maximum pressure regulator valve setting shall be 475 psig. A relief valve preset at 475 psig shall be installed on the low-pressure side of all oxygen service carts. Carts not so equipped shall not be used.
- Make sure oxygen servicing components are completely free of petroleum-based products, such as greases or solvents.
- To avoid heating by sudden compression, open and close all high-pressure oxygen valves slowly. If two valves are to be opened, open the down-stream valve first. Valves may be closed in any order.

NOTE

When utilizing multi-bottle oxygen servicing carts, use only one bottle at a time. Opening more than one bottle at a time could equalize all bottles opened.

a. The oxygen-servicing units are equipped with two pressure gauges. One gauge indicates pressure of the servicing cylinders and the other gauge indicates the pressure of the oxygen being transferred into the aircraft. Gradually increase the delivery pressure until the gauge on the low side of the unit regulator indicates 425 psig. After the flow to the aircraft system has stopped, the gauge on the cart should indicate pressure of the aircraft system. A final check should then be made by checking the gauge at the oxygen regulator in the aircraft.

b. Eye protection (safety goggles, safety glasses with side shields, or face shield) shall be worn by personnel performing oxygen servicing at aircraft connection point.

c. Gaseous oxygen servicing hose does not sufficiently provide a stable ground. Statically ground the Gaseous Oxygen Servicing Cart to a common ground before connecting servicing hose.

d. Personnel shall observe aircraft oxygen gauges at all times during servicing operations to prevent overfilling of tanks.

NOTE

If the aircraft oxygen system gauges can be observed to prevent overfilling while stationed at the oxygen-servicing unit, such as T-37 aircraft, one person can accomplish the servicing.

e. Personnel shall be stationed at the oxygen servicing unit at all times during servicing operations to shut off unit valves immediately upon receiving a command from the personnel watching the aircraft system gauges.

4.17 LIQUID OXYGEN SERVICING.

Liquid oxygen servicing refers to a LOX bottle exchange on the aircraft or a LOX cart servicing operation. For LOX bottle exchange operations, the operator is only required to wear eye protection (goggles or face shield). LOX cart servicing is not allowed during the fuel servicing portion of a CSO. For servicing with a LOX cart, the following procedures apply:

WARNING

- Do not allow LOX to contact petroleum products as fire or explosion may result.
- LOX will freeze and seriously damage human skin tissue upon contact.
- If LOX spills on asphalt or concrete expansion joint sealant, stop servicing or other operations within a 20-foot radius of spilled area. Do not walk or roll equipment over area of spill for at least 30 minutes (minimum) and until all frost and fog appearance has disappeared.

NOTE

Do not attempt to rewarm parts of the body that have been frozen by contact with liquid oxygen. Prevent further injury to the frozen area. Transport immediately to the emergency room of the nearest medical facility.

a. Fire Protection. Ensure a serviceable 150-pound wheeled Halon 1211 fire extinguisher or equivalent is placed within 50 feet of the LOX servicing operation.

WARNING

When servicing LOX in an exercise or training environment, chemical warfare defense ensembles and other chemical warfare suits, including chemical warfare masks, will not be worn, even underneath other coverings; they must be removed prior to LOX flow and not be donned until the lines are disconnected.

b. Protective Clothing and Equipment. When transferring LOX, personnel shall wear headcovering, eye goggles conforming to ANSI Z 87.1 (Personal Eye and Face Protection Devices Requirements), face shield (NSN 4240-00-542-2048) or locally purchased hard hat face shield combination, gloves, leather, welder's gauntlet cuff (A-A-50022B) (NSN 8415-00-268-7860) medium with gloves, cloth, work, cotton knit (A-A-55213) (NSN 8415-00-964-4760) medium as an insert; or gloves, leather (NSN 8415-00-268-7871) with glove inserts, wool (NSN 8415-00-682-6673) or equivalent; apron (NSN 8415-00-082-6108), coveralls, cotton white, cuffless trousers, long sleeve shirt, jacket, (Optional) and shoes which fit closely around the top, with rubber soles and heels. All items shall be clean and free of grease, oil, and fuel.

NOTE

- The above NSN data is for gloves sized "medium". Other sizes may be ordered as required, but all sizes must meet the criteria of the federal specification and military specification identified above.
- A BDU cap is recommended as head covering when LOX servicing connections are above eye level since it would afford more protection than the adjustable style cap with open back, typically worn as organizational head covering. Mesh caps are not authorized.
- The wool glove insert and cotton knit cloth work gloves used as inserts can be used interchangeably with either welder's gauntlet cuff leather gloves or leather gloves specified above.
- A leather boot approximately 8 inches in height with close fitting top and rubber sole and heel is recommended, since LOX spills normally subject one's foot area to a freeze burn exposure hazard. This type footwear when equipped with a hard protective toe area is generally classified as a safety shoe or boot.

c. LOX servicing hose does not sufficiently provide a stable ground. Statically ground the LOX Servicing Cart to a common ground before connecting servicing hose.

WARNING

Drip pans shall be kept clean and not be utilized for any purpose other than LOX servicing. Any residual LOX in drip pan should be allowed to boil off and not be poured off.

d. Service area shall be well ventilated, free of oil, grease, and fuel vapors.

e. A drip pan shall be placed under oxygen overflow vents to prevent contact of the LOX with oil or grease, which may be on the ramp.

f. Should a control valve become clogged with ice, thaw with water.

g. LOX servicing equipment should be purged to make sure no moisture is introduced into a liquid oxygen system and there is no moisture in or on filler fittings, nozzles, or valves where it may enter the aircraft system during servicing operations. When servicing several aircraft, one immediately after the other, the LOX servicing equipment need only be purged prior to first servicing operation.

h. Before filling the aircraft system, insure that the pressure relief valve on the LOX supply tank is operating properly.

i. A steady drip from the servicing nozzle aircraft filler valve connection that can be contained in a drip pan is acceptable. The drip can sometimes be eliminated by holding the hose, thereby removing the downward tension from the connections.

NOTE

Present aircraft liquid oxygen servicing connections cannot be made absolutely leak tight because of basic design deficiencies. Valves should not be discarded solely because of leaking connections. Perform a leak check on the female filler valve in accordance with TO 37C2-4-6-13 or TO 37C2-4-6-21 as appropriate.

j. Leaks which result in LOX running down the servicing nozzle or the side of the aircraft or which result in LOX spraying from the connections are dangerous. Leakage from any component or connection is a potentially dangerous situation.

WARNING

Allow the LOX system to stabilize (vent) after servicing for at least 30 minutes prior to use, buildup, or reading any gauges. Failure to do so may cause valve blockage from moisture and lead to system damage or injury to personnel.

k. The oxygen-servicing unit shall be disconnected from tow vehicle and located at the maximum distance from the aircraft permitted by the hose length. Hoses shall be kept free of kinks and sharp bends at all times. LOX hoses shall be drained and capped immediately after use.

4.18 LIQUID OXYGEN SERVICING IN AIRCRAFT SHELTERS/FTR.

The following applies when servicing LOX in a shelter/FTR:

a. A dedicated shelter/FTR may be used to fill converters removed from aircraft parked elsewhere. Follow procedures outlined in Paragraph 4.17. Do not perform other operations in the same shelter/FTR.

b. To service the aircraft themselves in individual shelter/FTR without converters being removed, stop other operations until the LOX servicing is completed and the LOX cart removed. Follow procedures outlined in Paragraph 4.17.

c. LOX cart servicing of an aircraft is not allowed during the fuel servicing portion of a CSO.

d. No electrical switches will be operated.

e. No other operations or maintenance will take place in the shelter/FTR.

f. The aircraft will be safed for CSO/maintenance.

g. No floor drains, traps, or other below floor areas will be within 20 feet of the LOX servicing operation. If drain channel is clean, underfloor weapons storage vault is exempt. MAJCOM may exempt F-15 first generation shelter guide rails as long as the rail channels are free of all hydrocarbons and rails are placed down in stowed position during LOX servicing (except those next to main landing gear).

h. All puddled or wet hydrocarbons are cleaned from shelter floor.

i. No non-LOX personnel or ignition sources are allowed within 20 feet of LOX servicing operation. Cellular phones and hand-held radios or any transmitting devices will not be used and will be turned off within 50 feet of the servicing area.

j. LOX cart will not be stored in shelter/FTR. LOX cart should be stored outside shelter/FTR in a separate splinter-protected location.

k. Following LOX servicing, LOX cart is removed from shelter then depressurized.

l. Clean, dedicated LOX drip pans or collection devices will be used to catch LOX. Flat floor pans (when used) should be at least 3 feet x 2 ½ feet x 3 inches.

m. Aircraft specific LOX servicing procedures are used.

n. Except for combat, the shelter doors will be positioned as follows (minimum):

(1) Alert shelters will have at least one aircraft door open.

(2) First generation HAS/PAS. The exhaust door and one aircraft entry door will be fully open.

(3) Modified first generation HAS/PAS. The shelter door will be open to the shelter centerline and exhaust door will be fully open.

(4) Second/Third generation HAS/PAS. One aircraft entry door may be fully opened or each aircraft entry door may be opened 10 feet (20 feet total). One exhaust door will be fully open.

4.19 NITROGEN SERVICING.

Nitrogen is used in pressure-operated equipment to expel other gases from their cylinders and for purging tubes and lines. Quality control procedures are outlined in TO 42B7-3-1-1.

a. Gaseous nitrogen (N_2) is a colorless, odorless, tasteless gas, slightly lighter than air. It is inert and does not react with other substances nor will it support combustion.

b. Liquid nitrogen (LIN) is a colorless, odorless liquid, which exists in the liquid state only at extremely low temperature (-196 °C or -320.8 °F).

c. The following general guidance applies to both gaseous and liquid nitrogen servicing. Specific information covering gaseous nitrogen servicing is addressed in Paragraph 4.20 and liquid nitrogen servicing in Paragraph 4.21. It is not necessary to ground or bond nitrogen servicing carts.

(1) Those persons not directly involved in nitrogen servicing operations should stay outside a 20-foot radius of the servicing point. Servicing personnel shall wear PPE required for either gaseous or liquid nitrogen servicing. Although nitrogen is an inert gas, it is advisable that servicing personnel keep their hands, feet, clothing, etc., clean and free of petroleum base products.

WARNING

- Do not direct gaseous nitrogen toward body or clothing. Serious injury or death may result from the high energy of compressed gas.
- Nitrogen can dilute and displace oxygen in a confined space or pit to a point where life support is endangered. Nitrogen shall therefore be used only in well-ventilated areas or where personnel are using self-contained breathing apparatus.

(2) Only qualified personnel shall operate nitrogen equipment or service aircraft systems.

4.20 GASEOUS NITROGEN SERVICING.

Nitrogen servicing units are equipped with two pressure gauges. One gauge indicates pressure of the servicing cylinders and the other gauge indicates the pressure of the nitrogen being transferred into the aircraft. Gradually increase delivery pressure into the aircraft system(s). After the flow to the aircraft system(s) has stopped, the gauge on the cart should indicate pressure in the aircraft system(s). A final check should then be made by checking the aircraft gauges.

a. If nitrogen gas is used to inflate aircraft tires, Class I (water pumped) nitrogen shall be used. Class II (oil pumped) nitrogen may cause an oil film to build up on the inside of the tire, soaking the rubber. Class II nitrogen will not be used for tire servicing. If compressed air is used later to inflate the tire, a combustible mixture is produced within the tire by the oil film in contact with compressed air.

b. If the aircraft system or component pressure gauge can be observed and the service pressure can be controlled at the point of service, only one person is required to service gaseous nitrogen. If this combination does not exist, two people will be required to service gaseous nitrogen. Safety goggles, safety glasses with side-shields, or face shield shall be worn by nitrogen servicing personnel.

c. When moving the nitrogen-servicing trailer, all valves except vent valves shall be closed and shall not be opened until the trailer is in the working area.

d. The servicing hose shall never be tightly stretched to reach a connection.

e. Nitrogen servicing units or bottles shall be positioned to prevent accidental damage to the aircraft or equipment.

f. Nitrogen servicing equipment shall not be left unattended after hook-up.

4.21 LIQUID NITROGEN SERVICING.

Protective clothing, equipment, and servicing procedures.

a. When transferring LIN, personnel shall wear head covering, eye goggles conforming to ANSI Z 87.1 (Personal Eye and Face Protection Devices Requirements), face shield (NSN 4240-00-542-2048), gloves, leather, welder's gauntlet cuff (A-A-50022B) (NSN 8415-00-268-7860) medium with gloves, cloth, work, cotton knit (A-A-55213) (NSN 8415-00-964-4760) medium as an insert; or gloves, leather (NSN 8415-00-268-7871) with glove inserts, wool (NSN 8415-00-682-6673), apron (NSN 8415-00-082-6108), cuff less trousers, long sleeve shirt, jacket, or coveralls, cotton

(NSN 8405-00-037-9274), and shoes which fit closely around the top, with rubber soles and heels. All items shall be clean and free of grease, oil, and fuel.

NOTE

- The above NSN data is for gloves sized "medium". Other sizes may be ordered as required, but all sizes must meet the criteria of the federal specification and military specification identified above.
- A BDU cap is recommended as head covering when LIN servicing connections are above eye level since it would afford more protection than the adjustable style cap with open back, typically worn as organizational head covering.
- The wool glove insert and cotton knit cloth work gloves used as inserts can be used interchangeably with either welder's gauntlet cuff leather gloves or leather gloves specified above.

b. It is not necessary to ground or bond nitrogen servicing carts.

c. Liquid nitrogen (LIN), when exposed to the atmosphere, absorbs and liquefies oxygen. If the surface of the LIN is slightly bluish, it is to be considered contaminated with oxygen. In this case, the LIN shall require the same handling procedures as LOX.

WARNING

Drops or splashes of LIN will freeze skin tissue.

NOTE

Do not attempt to rewarm parts of the body that have been frozen by contact with liquid nitrogen. Prevent further injury to the frozen area. Transport immediately to the emergency room of the nearest medical facility.

d. When LIN is being transferred from one container to another, the receiving vessel shall be filled as slowly as possible to minimize the thermal shock that occurs when any material is quickly cooled.

e. When moving the LIN servicing unit, all valves, except vent valves shall be closed and shall not be opened until the unit is in the working area.

f. LIN servicing units shall be positioned to prevent accidental damage to the aircraft or equipment.

g. LIN servicing equipment shall not be left unattended after hook-up.

h. Should a control valve become clogged with ice, thaw with water.

i. Insure that no moisture is introduced into a LIN system and that there is no moisture in or on fittings, nozzles, or valves where it may enter the aircraft system during servicing operations.

j. Before filling the aircraft system, insure that the pressure relief valve on the LIN supply tank is operating properly.

4.22 HYDRAZINE SERVICING.

NOTE

Refer to AFOSH STD 48-8 for hydrazine neutralization and dilution guidance.

Hydrazine is a widely used industrial chemical and is very corrosive and hypergolic. Hydrazine appears as a clear, oily liquid having an ammonia-like odor. Since individual sensitivity to the odor may vary, and since prolonged exposure may overcome sensory recognition, the odor cannot be relied upon as an indication or warning of overexposure.

WARNING

Skin contact with liquid hydrazine or exposure to concentrations of hydrazine vapor present a serious health hazard.

NOTE

Hydrazine is hazardous because it may enter the body via lungs (breathing), gastrointestinal tract (swallowing), or through the skin (absorption). Additionally, there is a fire hazard present with hydrazine-water mixtures. (See step c.)

a. Short Term (acute) Overexposure. If exposed to high concentrations of hydrazine for short periods, dizziness, nausea, or irritation of eyes, nose, throat, or lungs may result. Liquid contact may cause skin burns. In very high concentrations, unconsciousness may occur.

b. Long Term (chronic) Overexposure. If exposed to concentrations of hydrazine vapors above permissible exposure limits over long periods, damage to kidneys and liver may occur. Frequent skin contact with liquid hydrazine may also result in damage to kidneys and liver. A yellow discoloration of skin and eyes may be apparent. Refer to AFOSH STD 48-8 for a summary of health effects and for guidance covering the handling and use of hydrazine.

c. Fire Hazard. The 70 percent hydrazine and 30 percent water mixture used in the F-16 EPU is a flammable mixture. Fires involving hydrazine can be fought and extinguished with common extinguisher agents. Water is the preferred agent for fire suppression.

4.23 HYDRAZINE PROTECTIVE CLOTHING AND EQUIPMENT.

Air-supplied respirators are required for those operations in which engineering controls and work practices are not sufficient to reduce exposure below the permissible exposure limits. If respirators are used, they must meet the requirements of AFOSH STD 48-1 and 48-8. Because hydrazine can be absorbed through the skin, it is necessary to wear approved clothing during those situations where there may be contact with the liquid. Protective clothing approved for handling hydrazine is discussed in TO 1F-16CG-2-49GS-00-1, Protective Clothing for Handlers of Missile Fuels and Oxidizers. Occupational health requirements are outlined in AFOSH STD 48-8.

4.24 HYDRAZINE HANDLING PROCEDURES FOR F-16 AND U-2 AIRCRAFT IN-FLIGHT EMERGENCIES.

If an F-16 or U-2 aircraft develops an in-flight emergency, it may have to land at an airfield not equipped for F-16 or U-2 maintenance/servicing. In these situations, the Emergency Power Unit (EPU) or Emergency Starting System (ESS) will be secured to prevent inadvertent ground firing. Turnaround support for the EPU or ESS will be provided by the home base or by the nearest base with EPU/ESS support capability. The F-16 is equipped with a highly reliable and quickly responsive method of developing emergency electrical and hydraulic power. A monopropellant (hydrazine) powered EPU is on board the F-16 aircraft for this purpose. The U-2 is equipped with a highly reliable method of starting the engine in flight, should it stall. A monopropellant (hydrazine) powered ESS is on board the U-2 aircraft for this purpose. Hydrazine, referred to as H-70 (30 percent water and 70 percent hydrazine), is highly toxic, corrosive, and considered a Class III C combustible in terms of AFMAN 91-201. Definite hazards are associated with H-70 and shall require unique support from qualified home base personnel. The F-16 or U-2 pilot is thoroughly knowledgeable of the peculiar requirements associated with H-70. Non F-16 or U-2 bases shall require support from home bases for recovery of F-16 or U-2 aircraft with an activated EPU or ESS as follows:

a. General Guidance for Recovery, Isolation, and Support of Aircraft After In-Flight Operation of the EPU. In-flight operation of the EPU, as the result of electrical, hydraulic, or engine failure will normally result in the declaration of an IFE. Declaration of an IFE, for these reasons, is a positive indication that the EPU has operated in the hydrazine mode. After landing, the aircraft shall be taxied clear of active runway(s) into an area of isolation, pending hydrazine system integrity (H-70 leaks/spill) check.

b. At non F-16 or U-2 bases, the pilot, local base Bioenvironmental Engineer (BEE), and fire department personnel shall conduct a system integrity check as follows:

(1) Inspect the EPU overboard vent line (located at the lower fuselage, center of Main Landing Gear (MLG) doors at forward most portion), the area surrounding the EPU compartment, and the ground beneath for hydrazine leakage (clear oily liquid).

(2) Inspect the area around the ESS to include the H-70 detector pellet for evidence of leakage, and the ground beneath for hydrazine leakage (clear oily liquid).

WARNING

Due to the toxic characteristics of hydrazine, personnel testing liquids for confirmation of hydrazine shall be equipped with self-contained breathing apparatus as well as apron, gloves, and boots. Failure to comply with this warning could result in personal injury or death.

(3) Fire department personnel, equipped in full PPE, or equivalent may use Micro-Essential Laboratories litmus (pH) paper, catalog number 46, located in the map case in the cockpit of each F-16 or U-2, to determine if the suspect liquid is in fact hydrazine. If the litmus paper turns purple, assume the liquid is hydrazine.

(4) If no leak is noted or a leak is confirmed as not hydrazine, as determined above, the pilot will contact home base and request turnaround instructions.

4.25 TRANSIENT F-16 BASES/U-2 ENROUTE SUPPORT.

Transient support will involve only confirmation of the status of the EPU or ESS system (leaking or not leaking) and, if leaking, isolation and containment to minimize harmful effects of hydrazine.

a. Air Force Bases - Leaking EPUs or ESSs will be treated like hazardous chemical spills and handled accordingly.

b. Civilian Airports/Fields - The aircraft pilot will inform local authorities of the hydrazine leak and advise caution in approaching the aircraft and recommend being handled as a hazardous chemical spill.

4.26 HYDRAULIC AND OIL SERVICING.

In addition to the requirements outlined in aircraft -2 technical orders, the following shall apply to hydraulic/oil servicing of aircraft.

a. Servicing Equipment.

(1) Avoid spilling oil or hydraulic fluid on aircraft or maintenance stands.

(2) Hand operated hydraulic and oil-servicing carts need not be grounded during servicing operations.

(3) Position servicing equipment as far from any portion of the aircraft as cables/hoses will allow. Maintenance stands shall be properly positioned to obtain easy access to filler caps.

CAUTION

Some USAF aircraft use a commercial hydraulic fluid, which is not compatible with standard Air Force hydraulic fluids. Make sure that the aircraft technical orders and TO 42B2-1-3 requirements are followed to prevent contamination.

b. Servicing Containers.

(1) When servicing from cans or drums, ensure that cleanliness and product integrity are maintained.

(2) Keep each product segregated and properly identified.

(3) Carefully read the label before dispensing oil and hydraulic products to ensure the correct product is being used.

4.27 DRUM AND CONTAINER SERVICING.

Drum and container servicing will be in accordance with the following procedures:

a. Drum Fuel Servicing. When servicing aircraft and/or ground support equipment/vehicles from drums, the same grounding and bonding procedures used for aircraft fuel servicing shall apply. The fuel should be in the original sealed drum whenever possible. During emergencies and/or combat situations, drums may be filled with fuel by base fuels service personnel. Extreme care must be taken to ensure drum cleanliness. Drums which have previously contained chemicals, oils, or halogenated hydrocarbons shall not be used for fuel.

(1) Water and sediment are often found in fuels stored in drums. These contaminants must be removed prior to servicing from drummed stock.

(2) Aviation fuel shall be passed through a filter or filter separator prior to delivery into aircraft fuel tanks. Before delivery to aircraft or equipment, test each drum for water by using a drum sampling thief or other siphoning device.

b. Fuel Collection Containers. Containers/bowsers will be parked in a designated storage area approved by the base fire department and included in the base environmental protection plan. Parked fuel collection containers do not need to be grounded at anytime, but need to be bonded whenever filling or graining operations are being accomplished. Do not use plastic sheets to cover fuel bowsers, bladders, nor other containers; the sheets can collect static electricity that can discharge near fuel vapors. Oil or hydraulic fluids will not be stored in containers/bowsers stenciled for reclaimed fuel.

4.28 WATER, WATER-ALCOHOL, AND ENVIRONMENTAL FLUID SERVICING.

Cleanliness must be maintained in water, water-alcohol, and environmental fluid servicing. Fluids must be kept free of sediment at all times. Any aircraft water servicing (including potable water and demineralized water) may be accomplished simultaneously with fuel servicing or oxygen servicing provided that the fuel or oxygen servicing equipment is moved into the area and bonded prior to the start of any one operation. Grounding/Bonding of the water truck is not required. In addition, bonding wires must not be disconnected while any servicing pressurization or transfer is in progress. Fuel servicing by refueling trucks, hydrant hose carts or hydrant servicing vehicles is authorized simultaneous with water servicing unless there is a critical interference positioning problem with the servicing vehicles. There are no restrictions on servicing an aircraft with water during maintenance, cargo handling, or passenger loading.

a. Demineralized water is used for thrust augmentation in some jet engines. Quality control requirements are covered in TO 42C-1-16.

(1) Demineralized water vehicle positioning for aircraft servicing will be accomplished in accordance with procedures in TO 36A12-13-1-

131CL-1. The preferred method for all aircraft water servicing is to position the water truck either forward or aft of the aircraft, perpendicular (90°) to the direction of the fuselage.

(2) If ambient temperature is below 40 °F (5 °C), demineralized water will not be used in aircraft unless a system is provided to heat water supply.

(3) Water servicing may be accomplished inside hangars with Group Commander approval if servicing vehicle is outside hangar or if full length of servicing hose is used and hangar doors are open.

b. Environmental fluids consist of antifreeze and coolant mixture of water, demineralized water, propylene glycol and ethylene glycol. These fluids are primarily used in cold weather operations to service coolant for radar components.

(1) A ground liquid cooler cart, as described in TO 35E10-19-1 and TO 35E10-22-1, is used to service some aircraft, e.g., E-3A. The mixture consists of 62 percent uninhibited ethylene glycol and 38 percent reagent water (EGW).

(2) Environmental fluid servicing vehicle/cart positioning for aircraft servicing will be accomplished in accordance with procedures for positioning fuel vehicles. The fluid servicing vehicle/cart will be bonded to the aircraft before hoses are connected to aircraft.

WARNING

Aircraft alcohol vapors are toxic and adequate ventilation must be provided in areas where alcohol is handled. Never work in a confined area or space without mechanical ventilation or respiratory protection. Most alcohols are flammable liquids.

c. Water-alcohol mixtures are used for thrust augmentation in turbojet engines and for Anti-Detonation Injection (ADI) or internal coolant in reciprocating engines. Quality control requirements are covered in TO 42C-1-16. Water-alcohol servicing vehicle positioning for aircraft servicing will be in accordance with procedures in TO 36A12-13-1-131CL-1.

4.29 AIRCRAFT DE-ICING.

De-icing fluid can be applied to an aircraft with any or all of its engines operating as long as the following apply:

a. Personnel and equipment must remain outside the individual aircraft engine danger areas.

b. Avoid spraying any de-icing fluid into any engine intakes, aircraft ventilation, Environmental Control System (ECS) air inlets or Jet Fuel Starters (JFS) inlet and exhaust areas.

c. Do not apply de-icing fluid during any fuel servicing operations.

d. Do not apply de-icing fluid when any LOX equipment is within 25 feet. (De-icing fluids can be applied to aircraft having installed LOX converters as long as the access doors are closed.)

4.30 AIRCRAFT TIRE SERVICING.

The following general guidance applies to all aircraft installed tire inflation operations in excess of 50 psi.

a. Servicer shall comply with specific operating instructions and safety precautions prescribed for aircraft being serviced and inflating tools and servicing units being used.

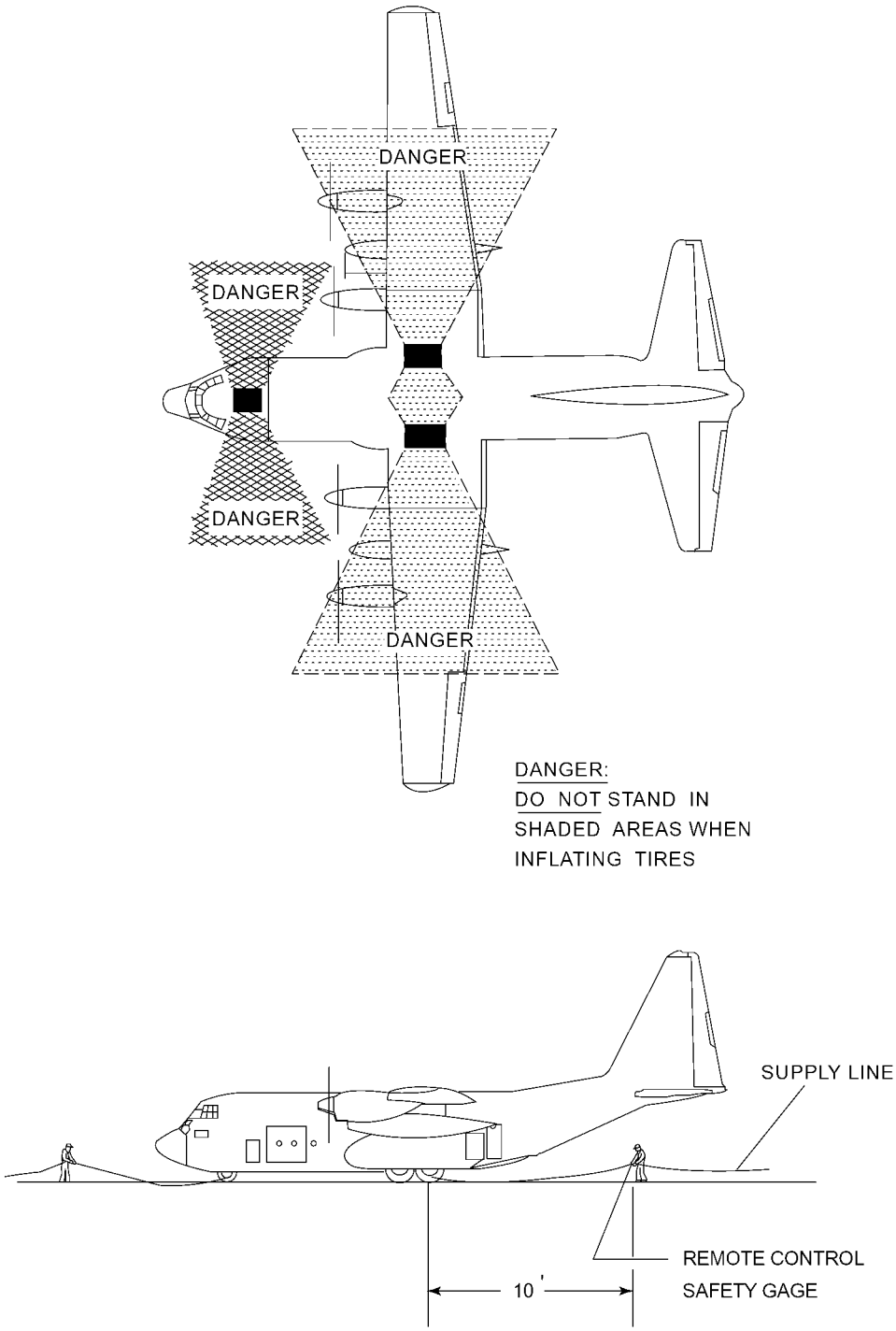
b. Impact resistant safety goggles or impact resistant safety glasses with sideshields shall be worn by the tire servicer.

c. The nitrogen or compressed air source used for servicing shall have a serviceable regulator for controlling service line pressure.

d. Servicing with compressed nitrogen shall be done only with Class I (water pumped) nitrogen.

e. An approved, calibrated tire inflating tool with relief valve and minimum ten foot servicing hose shall be used during tire inflation.

f. Servicer shall be positioned in front or aft of tire being serviced during inflation, at full length of inflating tool's hose. Hose shall not be tightly stretched. The immediate area to either side of tire being inflated shall be clear of personnel. (See Figure 4-2.)



TO-00-25-172-004

Figure 4-2. Aircraft Tire Servicing

CHAPTER 5
CONCURRENT SERVICING OPERATIONS

5.1 CONCURRENT SERVICING OF AIRCRAFT.

NOTE

On KC-135, MAF and Commercial aircraft, concurrent servicing is not required unless refueling/defueling with JP-4, loading/downloading munitions or explosives, or servicing LOX while performing maintenance. Simultaneous servicing of fuel while loading passengers and cargo, performing maintenance, aircrew members performing inspections, or operating aircraft systems is considered to be a normal servicing operation. Restrictions listed in Paragraph 5.6 and Paragraph 5.7 still apply.

Concurrent servicing is defined as the simultaneous servicing of fuel or oxygen with either passengers on board or the performance of minor maintenance, fleet servicing, or baggage or cargo loading/unloading. Refer to Chapter 6 for CSOs supporting the A-10, F-15, F-16 and F-22 aircraft. Concurrent servicing of aircraft with JP-4 or Jet B aircraft will require completion and approval of a System Safety Engineering Analysis (SSEA). As long as the provisions of this chapter are followed, a SSEA is no longer required for concurrent servicing of aircraft with high flashpoint fuels. Servicing operations pertaining to these aircraft when accomplished on a USAF installation are under the direct control of the USAF and will be accomplished in accordance with the provisions of this technical order. Fuel servicing and concurrent servicing of these aircraft will be done using approved checklists. Cargo containing explosives, oxygen or flammable gases or liquids shall not be loaded or unloaded during concurrent servicing operations. A Chief Servicing Supervisor (CSS) shall be provided by the USAF for all concurrent fuel servicing of contract airlift missions at military installations.

5.2 PERSONNEL REQUIREMENTS FOR FUEL SERVICING.

WARNING

Simultaneous fuel and oxygen servicing on an aircraft is NOT authorized.

CAUTION

Defueling during concurrent operations shall be limited to the single point method (closed fuel system). C-130 and C-141 troop doors and emergency hatches on the right SPR, side of the aircraft must be closed during concurrent servicing operations to isolate the cargo compartment from the fuel servicing safety zone.

The Air Force fuel servicing team will consist of the following:

a. Chief Servicing Supervisor (CSS).

b. SPR Monitor (SPRM) for each SPR in use (contractor aircrew member when servicing contract commercial carriers). 2F0X1 personnel trained and certified using MDS applicable procedures, or equivalent current training program, may perform simultaneous duty as both SPRM and fuels specialist.

c. A refueling panel monitor (when the refueling panel and the SPR are adjacent to each other, one individual may monitor both).

d. Fuel Specialists (2F0X1).

e. Passenger compartment monitor, i.e., aircrew member (when passengers on board).

5.3 RESPONSIBILITIES OF CSS.

a. Normal concurrent servicing operations.

(1) A Chief Servicing Supervisor (CSS) shall be present during concurrent operations. The CSS will primarily be stationed at the nose of the aircraft and will monitor the wing fuel vent outlets on the opposite side of the aircraft from the SPR location. A transient alert individual can also function as a CSS. The CSS can be either a USAF employee or a contractor support employee.

(2) When servicing is performed by contract, contractor personnel functioning as the CSS must have experience comparable to that required for an Air Force CSS. Base or unit commanders shall assure that the contractor's CSS has the required experience and capability.

(3) The CSS will wear a reflective vest with the letters CSS on the front and back. The letters will be at least six inches in height and four inches wide and made of reflective material at least one

inch in width. NSN 8415-00-177-4974 satisfies this requirement and shall be used unless otherwise specified in command directives.

(4) The CSS in concurrent operations shall also be responsible for controlling and monitoring all concurrent operations to include cargo/baggage loading/unloading, maintenance, fuel or oxygen servicing, and fleet servicing. CSS maintains continuous intercom contact with fuel servicing team members during the entire servicing operation (excluding 2F0X1 fuels specialists). C-9 aeromedical evacuation aircraft are authorized to conduct concurrent servicing operations away from home station using an alternate method of communication when aircraft intercom capability does not exist. Alternate communication procedures such as hand signals and/or voice communication will be agreed upon by the refueling team prior to start of the refueling operation. C-21 aircraft are authorized to conduct concurrent servicing using a deplaned aircrew member as the CSS. This individual can use either hand signals, voice communication, or intercom with the refueling team. In addition, the C-21 can use a ground power unit to supply aircraft electrical power. The refueling supervisor will ensure that the minimum number of personnel remain on the aircraft during refueling.

(5) Personnel who supervise portions of the operation; e.g., aerial port supervisor, maintenance team supervisor, or fleet service supervisor, shall coordinate each phase of their operation with the CSS and report immediately any condition that might jeopardize safety prior to beginning or during concurrent servicing operations.

(6) If concurrent operations are in progress, all personnel or their team chief will report to the CSS prior to entering the concurrent servicing area.

(7) The CSS will have full and final authority over all phases of concurrent operations and over all participating personnel, except the deployment and control of fire fighting and rescue units.

(8) During concurrent fuel servicing operations, the CSS may simultaneously perform CSS and fuel servicing supervisor duties.

(9) During concurrent oxygen servicing, the CSS will be an individual other than the person doing the actual oxygen servicing.

(10) CSS will ensure communications to the fire department through Job Control or the Command Post are immediately available and operational.

(11) Ensure all personnel involved in concurrent operations are briefed on the total requirements of servicing prior to commencing operations. This briefing will cover a general overview of the operation and emergency procedures.

(12) Assure fuel servicing equipment is properly bonded. Bond conductive maintenance or work stands to the aircraft when using the stand to access the aircraft fuel servicing receptacles or support the fuel hose during servicing operations.

(13) Ensure aircraft are not concurrently refueled if the fuel jettison (dump) system was used on the previous flight unless it can be positively verified that the jettison valve(s) closed after the fuel jettison operation. Verification can be accomplished by observing cockpit indications (provided they show the true status of the jettison valves) or by physically observing the fuel to stop exiting the jettison outlet(s) upon termination of the jettison operation. If neither of these verification actions can be done, then the aircraft must not be concurrently refueled until it undergoes at least one normal refueling operation to show that the jettison valves are closed.

(14) Ensure the fire department is notified at least 15 minutes before starting concurrent servicing operations.

(15) Supervise the movement of equipment into and out of concurrent servicing area.

(16) Assure connections of any ground power units are completed prior to starting the servicing operations. Equipment shall remain connected until the fuel servicing is terminated.

(17) Assure all concurrent operations are performed in compliance with this technical order.

(18) Assure the proper number of fire extinguishers are available (Table 3-1).

(19) Aircrew members may remain on board the aircraft during concurrent servicing operations as directed by the MAJCOM. When remaining on board, all safety procedures outlined in this technical order will be followed. Entering or exiting the aircraft shall be limited to performing essential duties associated with the concurrent servicing operation.

(20) Prior to beginning servicing operations of commercial contract carriers, the CSS shall contact the commercial carrier's technically qualified personnel to:

(a) Provide guidance on the duties and physical positioning of commercial contract carriers personnel during concurrent operations.

(b) Discuss any unfamiliar system characteristics or deficiencies.

(c) Determine and jointly approve the timing of any maintenance cargo or baggage loading or other activities to be accomplished during the concurrent servicing operation.

(21) Ensures the fuel servicing equipment operator operates the deadman control in all concurrent servicing operations.

(22) Ensures members of the maintenance servicing crew assist in setting up and removing fuel servicing equipment from the fuel servicing area.

WARNING

With the SPR nozzle crank handle in the closed position, check the strainer coupling quick disconnect device for positive locking. Prior to pressurizing the hose, be sure the nozzle is securely locked to the aircraft by attempting to remove the nozzle with the nozzle crank handle in the open position. 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. On aircraft with Refueling Teams, the team member connecting the refueling receptacle will be responsible for testing the strainer quick disconnect locking device for positive engagement and assuring the refueling nozzle is securely locked.

(23) Ensures proper connection of the SPR nozzle to the aircraft.

(24) Ensures that fuel servicing vehicle engines are shut off when the vehicles are unattended (e.g., during a pre-briefing that is conducted away from or out of sight of the vehicles).

b. Additional requirements for CSS with passengers/patients on board.

WARNING

Voice contact must be established and maintained at all times during the fuel servicing portion of concurrent servicing operations when passengers are on board the aircraft. The aircraft intercom system should be used as the primary means of maintaining voice contact between the fuel servicing team members. If the aircraft intercom system is inoperative and cannot be used to maintain voice communications, portable hand-held radios may be used to provide voice contact subject to the following stipulations. Radios can be used within the FSSZ, however, only intrinsically safe radios can be used within 10 feet of any aircraft fuel vent outlet, fuel spill or fuel tank truck being filled from aircraft defueling.

(1) Remain in constant voice contact with loadmaster or Air Mobility Command (AMC) passenger representative in passenger compartment, the cockpit aircrew and fuel servicing team until the fuel servicing operation is completed.

(2) Passengers may enter or exit the aircraft during fuel servicing provided either:

(a) a jetway is used

(b) or if a mobile staircase or aircraft integral stairs are used and the fuel servicing operation is on the opposite side of the aircraft and the passengers do not come closer than 25 feet from any aircraft fuel vent outlet. For C-9 aircraft single point fuel servicing, litter patients, ambulatory patients and passengers may deplane or enplane as necessary.

c. CSS actions for hazardous situations:

(1) Stop fuel flow.

(2) Determine if evacuation of passengers from the aircraft is required.

(3) Initiate normal or emergency evacuation of the aircraft as necessary.

(4) Coordinate with fire department personnel as needed.

5.4 RESPONSIBILITIES OF OTHER PERSONNEL PARTICIPATING IN CONCURRENT SERVICING OPERATIONS.

a. Normal concurrent servicing operations.

(1) Personnel who supervise portions of the concurrent servicing operations, e.g., aerial port, maintenance team, passenger service, or fleet service shall coordinate each phase of their operation with the CSS and report any condition that might jeopardize safety prior to and during concurrent servicing operations.

(2) Personnel can use the portable electronic equipment specified in Chapter 3 of this technical order.

b. Additional personnel requirements for concurrent servicing operations with passengers/patients on board. A loadmaster or AMC Passenger representative will be positioned in the passenger compartment and be in intercom contact with the CSS. They will:

(1) Notify passengers of the concurrent servicing operations and provide them the option to deplane if practical.

(2) Ensure that personnel/passengers do not smoke during fuel servicing operations.

(3) Ensure emergency exits and aisles are unobstructed and not blocked. Escape slides will be armed.

(4) Assist in the evacuation of passengers in an emergency.

(5) Make sure a ramp or staircase is in the proper position and unobstructed to enable exit in an emergency.

(6) Aircraft personnel entry/exit doors within the FSSZ should be closed during fuel servicing operations.

c. Medical evacuation aircraft will:

(1) Have two qualified medical crewmembers in attendance in the aircraft to assist in the evacuation of patients and passengers in the event of an emergency.

(2) Ensure the exits are open as much as practical as determined by the Senior Medical Representative in consideration of weather and patient conditions. Under no condition will the exit be locked during servicing operations.

5.5 RESPONSIBILITIES OF SUPERVISORY CONTRACTOR REPRESENTATIVE (SCR).

a. The SCR will:

(1) Be under the direct control of the Air Force CSS and will respond to all CSS directions.

CAUTION

SCR will determine if aircraft fuel jettison system was used since departing last location. If the system was used, concurrent servicing operations will not be accomplished until it is determined that the jettison valves are closed.

(2) Be stationed at the refueling control panel and SPR location to connect and disconnect the fuel nozzle to the aircraft SPR for required fuel servicing. For DC-9 contractor aircraft, the fuel nozzle will be connected and disconnected by USAF personnel, such as transient alert. The fuel servicing equipment operator should not perform this task.

NOTE

For commercially contracted cargo-only aircraft where the fuel control panel/fuel system control mechanism is located on the outside of the aircraft (L-100, L-188, DC-9, and B-727), use of the aircraft intercom system by fuel servicing ground crews is not required. If any personnel (flight or ground crew members) are to remain on board the aircraft during fuel servicing operations, then voice contact must be established and maintained between the personnel remaining on board the aircraft and the fuel control panel at all times during the fuel servicing operation.

(3) Monitor fuel vent outlets on the same side of the aircraft as the SPR location and maintain constant intercom contact with CSS during concurrent servicing operations.

(4) Advise the CSS when a potential safety hazard is observed or exists. The commercial airline representative operating the fuel control panel shall terminate fuel servicing immediately when directed to do so by the CSS. Fuel servicing will not be resumed until any existing safety hazard has been corrected and the CSS directs resumption of the servicing operation.

(5) The SCR or his representative shall ensure the fuel servicing nozzle is securely locked to the aircraft by attempting to remove the nozzle with the

poppet valve in the open position prior to pressurizing the system. If the SCR or designated contractor representative is able to remove the nozzle from the aircraft SPR with the poppet valve open, the fuel servicing operation will not be started. The fuel servicing unit/hydrant hose cart operator will immediately remove the nozzle from service. If the poppet valve on a SPR nozzle is closed, after the initial check and prior to pressurization, then another nozzle to aircraft lock check is required.

(6) The SCR shall provide two intercom headsets and cords, one 100-foot and one 50-foot, for Air Force use. The 100-foot cord shall be used by the CSS. All aircraft external intercom plug-ins must be operational and usable.

NOTE

When fuel servicing with government provided fuel on a USAF (or other) installation, the USAF (or other service) shall furnish additional personnel for monitoring each fuel nozzle connection where the number of personnel required exceeds those specified in the contract.

(7) Prior to beginning concurrent servicing operations, the SCR shall establish a liaison with the CSS to:

(a) Determine specific servicing requirements, to include if unique bonding sequence is required, for the aircraft.

(b) Discuss any unfamiliar system characteristics or deficiencies.

(c) Provide guidance on the duties and physical positioning of the commercial carrier's technical personnel during the concurrent servicing operation.

NOTE

A qualified SCR shall be present for supervision and control of the commercial contractor personnel involved in the concurrent servicing operation, to include subcontractor personnel, such as caterers, cleaning crews, and the flight crew. The SCR shall provide the safety expertise as related to commercial carrier's aircraft and shall notify the CSS of any potential safety hazards.

(8) Determine and jointly approve the timing of maintenance, cargo baggage loading/unloading, fleet servicing or other activities (food service, cleaning, etc.) to be accomplished during the concurrent servicing operation.

b. Additional requirements for SCR with passengers on board.

(1) The SCR will provide one operable 50-foot headset for each SPR/vent monitor and a 100-foot or longer cord and headset for the CSS (minimum of three headsets required for Air Force use). The SCR must also ensure the fuel control panel operator has a headset and remains on intercom during the fuel servicing operation.

(2) The SCR must also ensure a member of the aircrew or a contractor representative is in intercom contact in the cockpit and cabin areas when passengers are on board during fuel servicing. This individual will be in constant intercom contact with the CSS.

(3) The SCR will ensure the aircraft external intercom plug-in jacks are in good working order. If intercom contact cannot be maintained between the CSS, fuel control panel operator(s), vent/SPR monitor(s), and the individual in the cockpit/cabin area with the passengers, fuel servicing with passengers on board will not be done.

5.6 CARGO/BAGGAGE HANDLING OPERATIONS.

a. Winching cargo and/or movement of nonpalletized self-propelled vehicles/equipment into or out of aircraft in conjunction with concurrent servicing is not authorized except on the C-5, C-130, C-141, C-17, and KC-10 aircraft.

b. Passengers will not be allowed in the cargo compartment while winching of rolling stock or pallets is being accomplished.

c. Use of the winch in the cargo compartment of C-5 and C-141 aircraft is prohibited during defueling operations.

d. Cargo containing explosives, oxygen, or flammable gases or liquids shall not be loaded or unloaded during concurrent servicing operations. Under combat conditions or simulated combat exercises, loading or unloading cargo containing explosives or munitions shall be accomplished according to TO 11A-1-33. Munitions will not be on-loaded or off-loaded from airlift aircraft during concurrent servicing operations.

5.7 MAINTENANCE RESTRICTIONS DURING CONCURRENT SERVICING OPERATIONS.

CAUTION

A malfunction of any component in the aircraft fuel system will require immediate shut down of the operation until the malfunction is corrected.

a. Transmitting on aircraft HF radios, or operating radar, radar altimeter, or SKE equipment will not be done during concurrent servicing operations. Inertial Navigation System (INS) and Fuel Saving Advisory System (FSAS) may remain energized. SATCOM radios may be operated in the transmit mode if the antenna beam is pointed at least ten degrees above the horizon.

b. Power-on maintenance of electrical equipment on the exterior of the aircraft is prohibited, unless the equipment is located outside the FSSZ.

c. Maintenance requiring the use of jacks shall not be performed with the exception of single wheel changes on multi wheel main landing gear or dual nose wheel landing gear provided the jacking is performed at the affected gear. For the C-17 aircraft, jacking can be performed on the main landing gear using the integral jacking system.

d. Maintenance in the aircraft wheel well area shall be limited to tire changes and Liquid Nitrogen (LIN) servicing on C-5 aircraft during concurrent servicing operations. LIN service vehicles must be positioned prior to the start of servicing operations and not moved until the servicing operations are complete.

NOTE

Maintenance and servicing of unpressurized hydraulic systems during concurrent servicing operations is authorized.

e. No flammable fluid carrying lines will be broken unless equipped with quick disconnects.

f. Maintenance or repair of the aircraft or engine fuel systems which require the opening of fuel lines, fuel tanks, or replacement of plug-in components is prohibited.

g. Power tools shall not be used during concurrent servicing operations or when bulk shipment of explosives, oxygen, or flammable gases or liquids are being loaded/unloaded.

h. Personnel not directly involved in the oxygen servicing operation will remain outside the 20-foot radius of the Liquid Oxygen (LOX) servicing safety zone.

5.8 FIRE PROTECTION REQUIREMENTS.

Fire protection requirements for concurrent servicing are:

a. One Halon 1211 fire extinguisher for each SPR connection location being used.

b. At least a 15 minute notification from MOC or the Command Post to the fire department prior to starting concurrent servicing operations is required to allow aircraft rescue and fire fighting vehicle positioning for a three minute response time. When two or more aircraft are being concurrently serviced at different locations, an ARFF vehicle will be on standby posture. The Base Fire Chief determines position for optimum response.

NOTE

If hazardous cargo is involved, the fire department will also be notified of its type and quantity.

c. With passengers/patients on board and servicing with JP-4 or Jet B fuel, a major aircraft rescue and fire fighting vehicle (P-2//19/23) will be positioned at the aircraft.

NOTE

If passengers/patients are on board, the number of passengers/patients will be given to the fire department.

5.9 EQUIPMENT REQUIREMENTS.

a. Fuel servicing equipment approved for concurrent servicing operations:

(1) Without passengers:

(a) MH-2 hydrant hose cart being used with Type I or Type II modified hydrant systems when equipped with a magnetic KISS system or deadman control.

(b) Hydrant servicing vehicles or hydrant hose trucks being used with Type I, II, or III hydrant systems equipped with deadman controls.

(c) R-5/R-9 fuel servicing trucks equipped with deadman controls.

(d) Any Meyerinck, Cla-Val, OPW, Emco-Wheaton or Nova Group pantograph.

(e) R-11 fuel servicing trucks when equipped with American Petroleum Institute (API)/In-

stitute of Petroleum (IP) STD 1529, Type C, Grade 2/3 aviation servicing hose assemblies with two-piece, onetime use, internally expanded forged brass or bar stock body couplings and brass or 300 series stainless steel serrated ferrules.

(f) Fuels Operational Readiness Capability Equipment (FORCE).

(2) With passengers on board:

(a) Hydrant servicing vehicles, hydrant hose trucks, and fuel servicing trucks equipped with deadman controls and at least 50 feet of noncollapsible fuel servicing hose or MIL-DTL-26521K fuel servicing hose.

(b) MH-2 series hydrant hose carts modified with semi-hard (noncollapsible) fuel servicing hose, or MIL-DTL-26521K fuel servicing hose straight throat nozzle, and equipped with a magnetic KISS system or deadman controls.

NOTE

The modified MH-2 series hose cart will only be used when a hydrant servicing vehicle or hydrant hose truck is not available. During peacetime operations, fuel servicing trucks equipped with collapsible fuel servicing hose will not be used for concurrent servicing while passengers are on board.

(c) Any Meyerinck, Cla-Val, OPW, Emco-Wheaton or Nova Group pantograph.

(d) R-11 fuel servicing trucks when equipped with API/IP STD 1529, Type C, Grade 2/3 aviation servicing hose assemblies with two-piece, onetime use, internally expanded forged brass or bar stock body couplings and brass or 300 series stainless steel serrated ferrules.

(e) Fuels Operational Readiness Capability Equipment (FORCE).

b. Powered AGE used inside the FSSZ will meet the requirements outlined in Paragraph 4.1.

c. Operating external power units will be parked at least 50 feet from pressurized fuel carrying servicing components and at least 25 feet from aircraft fuel vents during fuel servicing operations. They will be placed outside the fuel servicing safety zone and when possible positioned upwind from the servicing operation.

d. Vehicles authorized inside the fuel servicing safety zone during concurrent servicing operations shall maintain at least a 25-foot separation distance from the aircraft fuel vent outlets (except Boeing 747/757/767 aircraft which are acceptable for having authorized vehicles pass underneath but may not stop or be parked directly beneath the fuel vent outlets) and a 25-foot separation distance from pressurized fuel servicing system components during fuel servicing operations. All other vehicles shall remain outside of the FSSZ.

e. The C-9 aircraft APU will normally be used during all single point fuel servicing operations to supply electrical and pneumatic power for the ECSs and life support medical equipment. If the C-9 APU becomes inoperative and the aircrew has determined that electrical and/or pneumatic power are medically essential, suitable ground power units will be connected and operated. These back-up power sources shall be immediately available during all medical evacuation operations.

WARNING

In the event a heating or air conditioning unit stops running while connected to the aircraft, disconnect the duct immediately.

f. When ground heaters or air conditioners are required for passenger comfort, they may be used in the FSSZ subject to the following:

(1) Electrical motors to be used within:

(a) 10 feet of the aircraft fuel vent outlets, open port refueling receptacles, fuel spills, or fuel trucks being filled (bottom loading or from aircraft defueling) must meet the NEC requirements for Class I, Division 1 (Zone 1) locations.

(b) The fuel servicing safety zone but not within 10 feet of the aircraft fuel vent outlets, open port refueling receptacles, fuel spills, or fuel trucks being filled (bottom loading or from aircraft defueling) must meet the NEC requirements for Class I, Division 2 (Zone 2) locations.

(2) Units driven by electrical motors not meeting Class I, Division 2 (Zone 2), requirements may be used providing they are stationed outside the FSSZ and upwind whenever possible. The heating and air conditioning units shall be started prior to connecting the open end of the duct to the aircraft and stopped after the duct has been disconnected.

g. Contractor/subcontractor vehicles involved in concurrent servicing operations must comply with the standards in this TO. Those vehicles not meeting these requirements will not be allowed in the fuel servicing safety zone. The SCR will inform the CSS of the status of contractor/subcontractor vehicles prior to the start of concurrent servicing operations.

NOTE

Maintenance stands and equipment used under the aircraft during fuel servicing operations will be positioned to ensure the aircraft is not damaged when it settles as the aircraft is fueled.

h. If workstands are used, bond to the aircraft. Workstands shall not be moved except under the direction of the CSS.

i. An external staircase will be provided for C-5 upper deck passengers whenever the internal stairs are stowed due to cargo loading operations being conducted concurrent with fuel or oxygen servicing operations.

j. Required fleet servicing equipment.

k. Required passenger handling equipment.

CAUTION

The 40-K loader open flame heater will not be used in the concurrent servicing area.

l. Required cargo handling equipment for the specific aircraft and its cargo being on or off loaded.

m. At least four intercom headsets for C-5 and C-141, two with 100-foot cords and two with 50-foot cords. For C-130 at least three intercom headsets, one with a 75-foot cord and two with at least 50-foot cords with passengers on board.

n. Bond conductive maintenance or work stands to the aircraft when using the stand to access the aircraft fuel servicing receptacles or support the fuel hose during servicing operations.

Table 5-1. Concurrent Servicing

Type	Cargo	Passengers	Power-On Maint.	APU	Servicing Oxygen
Airbus A300/310	A	A	A*	A	N
A330	A	A	A	A	N
B-1A	N/A	N/A	A	A	A
B-2	N/A	N/A	A	A	A
B-52	N	N/A	A	N/A	A
B-707, C-18, C-137	A	A	A	A	A
B-727, C-22	A	A	N	A	N
B-737, C-40	A	A	N	A	N
B-747, DC-8, DC-102	A	A	A	A	A
B-757, (C-32), B-767, B-777	A	A	A*	A	N
C-5, C-130, C-141	A	A	A	A	A**
C-9	N	A	N	A	A
C-17A[1]	A	A	A	A	A
C-20, C-37	N/A	A	N	A	N
C-27	A	A***	A	A	N
C/KC-135 (all models)	A	A	A	A (KC-135 only)	A

Table 5-1. Concurrent Servicing - Continued

Type	Cargo	Passengers	Power-On Maint.	APU	Servicing Oxygen
DC-9, MD-81, MD-82, MD-83, MD-88, MD-90	A	A	N	A	A
E-3	N	N	N	A	N
E-4B	N	A	A	A	A**** Power-On
E-8	N/A	A	A	A	N
Gnat UAV	N	N	N	N	N
KC-10	A	A	A	A	A
L-100, L-188, DC-9	A	L-188 only	Power-off Only	A	N
L-1011	A	A	N	A	N
MD-11	A	A	A	A	A
Predator UAV	N	N	N	N	N
P-3	N	A	N	A	N
T-43	A	A	N	A	N
TR-1	N/A	N/A	A	N/A	A Power off
VC10	N	N	A	A	N
VC-25A[2]	N	A	N	A	N

A = Approved
N = Not evaluated (not approved)
N/A = Not applicable

[*] Allowed on the aircraft exterior outside the FSSZ.

[**] For C-5 aircraft, LOX servicing cannot be done on the same side as an operating APU.

[1] When multiple source refueling with trucks, the refueling truck placed in the left rear quadrant of the aircraft will need to be placed within 10 feet of the aircraft fuselage.

[***] Includes litter patients.

[****] Aircraft electrical power may be provided by either an external Ground Power Unit (GPU) or by operating aircraft engine number 1 or 2 and/or the aircraft APU.

[2] Approved for only limited concurrent servicing operations (i.e., not to include oxygen servicing, galley servicing or on-board mechanized baggage handling equipment).

CHAPTER 6
SPECIALIZED AIRCRAFT FUELING OPERATIONS

6.1 INTRODUCTION.

This section describes the following fueling operations:

a. Concurrent Servicing Operations (CSOs) supporting Combat Sortie Generation (CSG) Authorized Only for A-10, F-15, F-16, and F-22 aircraft.

b. Hot refueling operations.

c. Aircraft to aircraft fueling operations.

d. Fuel operations using the Aerial Bulk Fuels Delivery System (ABFDS) with Alternate Capability Equipment (ACE).

e. Rapid/Wet Wing/Hot Defueling.

6.2 CONCURRENT SERVICING OPERATIONS (CSO) SUPPORTING COMBAT SORTIE GENERATION (CSG) FOR A-10, F-15, F-16, AND F-22 AIRCRAFT.

CSOs are the simultaneous fueling, and loading/unloading of munitions/ammunition, aircraft reconfiguration, aircraft -6 TO inspections, and other aircraft servicing such as oil, nitrogen, and hydraulic fluid. Oxygen servicing will not be accomplished during fuel servicing. CSOs provide units operational flexibility in managing resources and a rapid means of generating mission capable aircraft. CSO procedures may be used during actual contingencies, scheduled exercises, and daily flying operations. Specified approved procedures and safety precautions are contained in the appropriate MDS specific -33-1-2, -2, and -6 technical orders and applicable AFMANs, AFOSH STDs, and AFI 91-203. Refer to AFI 21-101 and MAJCOM supplements for additional guidance. Any additional capabilities must be evaluated through the SSEA and approval given prior to performing new CSO procedures.

6.2.1 CSO Requirements. CSOs will not be started unless there is a Concurrent Servicing Supervisor (CSS) at each CSO location requiring a CSS.

6.2.1.1 CSOs Requiring a Concurrent Servicing Supervisor (CSS).

WARNING

- Simultaneous fuel and oxygen servicing on an aircraft is NOT authorized.
- Electrical “power-on” portions of -6 inspections are NOT authorized during concurrent munitions loading/unloading, aircraft reconfiguration, and fuel servicing operations. Power-on portions of -6 inspections are accomplished prior to or upon completion of the concurrent munitions loading/unloading, aircraft reconfiguration, and fuel servicing operation.

NOTE

- Once a fuel servicing operation has begun no other fluid/gaseous servicing will be started until the fuel servicing is completed.
- For fuel servicing information on explosives-loaded aircraft, refer to Paragraph 4.12. For handling and maintenance instructions of explosives-loaded aircraft, refer to TO 11A-1-33.
- Deadman controls will be installed on all approved refueling equipment used in conjunction with CSOs. Ensure the fuel servicing equipment operator operates the deadman control in all concurrent servicing operations.

The key function requiring the CSS is refueling/defueling. When no refuel/defuel operations are taking place concurrent with any other maintenance/munitions tasks, a CSS is not required.

6.2.1.1.1 Simultaneous fuel servicing with aircraft -6 and -6WC inspections.

6.2.1.1.2 Simultaneous fuel servicing with munitions/ammunition loading/unloading.

6.2.1.1.3 Simultaneous fuel servicing with aircraft reconfiguration.

6.2.1.1.4 Simultaneous fuel servicing and other aircraft servicing such as oil, nitrogen, and hydraulic fluid.

6.2.1.1.5 Simultaneous fuel servicing with loading/unloading of munitions/ammunition, aircraft reconfiguration, air-

craft -6 TO inspections, and other aircraft servicing such as oil, nitrogen, and hydraulic fluid.

NOTE

Electrical "power-on" portions of -6 inspections are not authorized during concurrent munitions loading/unloading and fuel servicing operations. Power-on portions of -6 inspections are accomplished prior to or upon completion of the concurrent munitions loading/unloading and fuel servicing operation.

6.2.2 CSOs Not Requiring a Concurrent Servicing Supervisor (CSS).

6.2.2.1 Any or all simultaneous munitions/ammunition loading/unloading with aircraft -6 and -6WC TO inspections, aircraft reconfiguration, and other aircraft servicing such as oil, nitrogen, and hydraulic fluid.

NOTE

When a CSS is not required the weapons load crew chief is responsible for and controls all actions concerning the aircraft during loading and unloading operations. See AFI 21-101, Chapter 4 for detailed responsibilities.

6.3 CONCURRENT SERVICING SUPERVISOR (CSS).

The on-site supervisor responsible for all aspects of fuel servicing, munitions/ammunition loading/unloading, aircraft reconfiguration, aircraft -6 TO inspections, and other aircraft servicing performed during CSOs. The key function requiring the CSS is refueling/defueling. When no refuel/defuel operations are taking place concurrent with any other maintenance/munitions tasks, a CSS is not required. The individual shall receive training on safety requirements and potential hazards of concurrent servicing operations and be certified as required by AFI 21-101, MAJCOM, and local maintenance/training directives. The CSS:

a. Is a 5 skill-level with a 2AXXX or 2WXXX maintenance AFSC and at least 1 year airframe experience.

b. Is a safety supervisor who will only supervise one CSO at a time.

c. Maintains full authority over all safety aspects of CSOs and participating personnel, except the deployment and control of fire fighting and rescue units.

d. Ensures all CSOs are performed in accordance with applicable MDS technical orders and directives.

e. Coordinates with personnel participating in CSOs. Personnel report to the CSS prior to entering the concurrent servicing area. Personnel coordinate each phase of their operation with the CSS and report any condition(s) that may jeopardize safety prior to or during CSOs.

f. Supervises movement of equipment into and out of the concurrent servicing area.

g. Ensures all personnel involved are briefed on the total requirements prior to commencing operations. The briefing provides an overview of the CSO, safety requirements and emergency procedures.

h. Ensures the fire department is notified at least 15 minutes before starting CSOs, ensures communications to the fire department through MOC are immediately available and ensures proper numbers of fire extinguishers are available to support the CSO.

i. Ensures connections of any ground power units are completed prior to starting CSOs. Equipment shall remain connected until the fuel servicing is terminated.

j. Wears a reflective vest for ease of identification. The letters will be a least six inches in height and four inches wide and made of reflective material at least one inch in width. NSN 8415-00-177-4974 satisfies this requirement and shall be used unless otherwise specified in command directives.

6.3.1 CSO Accomplishment. CSOs are accomplished in approved explosives and fuel cited areas, (i.e., open ramps or shelters). CSOs can be done on a single aircraft parked nose-in or nose-out on centerline of shelters/FTR. Two aircraft may be parked in a second or third generation HAS/PAS (double stuffing), but only one of the aircraft can undergo a CSO at a time. Refer to Table 3-1 for fire protection requirements.

6.4 HOT REFUELING (FUELING WITH ENGINES RUNNING).

This type of refueling requires the approval of the MAJCOM of the activity involved. When hot refueling involves the resources of more than one command, the approval of each affected MAJCOM is required. Hot refueling provides minimum aircraft turnaround times and reduces fueling personnel and equipment support requirements. However, it presents hazards which are not normally encountered in other fueling operations. Consequently, personnel who are responsible for supervising and conducting hot refueling must have:

a. A thorough knowledge of all equipment and systems they operate.

b. A thorough knowledge of and observe all safety procedures.

c. A thorough knowledge of and follow the sequential steps for each operation.

d. Undergone annual certification per command directives.

6.5 HOT REFUELING REQUIREMENTS.

Hot refueling will not be attempted unless individual aircraft technical order guidance, checklists and appropriate individual fueling systems are available. Aircraft will not be hot refueled without fully qualified ground servicing crews. Hot refueling shall not be performed until SSEA validation procedures have been accomplished on the aircraft, fueling systems and facility and until the SSEA has been approved by HQ AFMC/SES. Refer to Table 6-1 for those aircraft and refueling systems that have been evaluated for hot refueling operations. The use of approved refueling equipment is mandatory. Any deviation from this policy shall be approved by HQ AFMC/SES. In those cases where combat or emergency situations require the use of hot refueling, the MAJCOM commander may authorize deviation from this policy. Refer to Table 3-1 for fire protection requirements. A MAJCOM or MAJCOM delegated team composed of Safety, Fuels Servicing, Aircraft Maintenance, Operations, Fire Protection, and the Liquid Fuels Engineer shall certify individual hot pit refueling sites on a case by case basis. The command will provide specific guidance for site certification and personnel training/certification. Specific items to be included in the MAJCOM Directive are:

a. Procedures for certifying the site to be used for the fueling operation.

b. Procedures for certifying and training personnel involved in the fueling operation.

c. Define responsibilities of various functional agencies to include establishment of the MAJCOM Office of Primary Responsibility (OPR).

d. Other information necessary to assure a successful fueling operation is accomplished.

6.6 MINIMUM GROUND CREW.

The minimum hot refueling ground crew requirements for single aircraft servicing will be as specified in applicable MDS Specific technical orders. For hot refueling two or more aircraft simultaneously with equipment such as the Type IV hot refueling system, the minimum ground crew per aircraft will be as specified above plus one overall hot pad supervisor (AFSC 2AXXX five level or above). All hot refueling ground crew members will be certified to perform hot refueling operations as required by AFI 21-101, MAJCOM and local maintenance/training directives upon initial qualification and annually thereafter.

6.6.1 For Flow Through Revetments (FTRs). For FTRs the 50-foot aircraft taxiing/200-foot aircraft parking area criteria only applies to fore and aft of the FTR. The revetment wall minimizes the probability of spreading of fire or an explosion.

NOTE

Hot refueling personnel will not wear items of clothing or accessories that present Foreign Object Damage (FOD) potential.

6.7 HOT PAD REFUELING SUPERVISOR.

a. This individual (AFSC 2AXXX five level or above) has overall responsibility for the operation, assures compliance with the applicable refueling checklist and assures that aircraft entering the hot refueling area have had all live munitions downloaded or safed in accordance with applicable aircraft technical orders. Aircraft returning from a munition delivery will be cleared for hot refueling by personnel qualified to “safe” the aircraft and munitions. Personnel or equipment on the hot refueling pad will not be positioned in front of forward firing munitions. The hot pad refueling supervisor will brief the team members on their assignment and responsibilities considering aircraft configuration and ground conditions (i.e., attached external fuel tanks, ECM pods, chaff dispenser or pods, wind direction, positioning of aircraft, FOD potential, and emergency procedures).

b. When simultaneously hot refueling two fixed wing aircraft, the hot pad refueling supervisor must coordinate the operations of each aircraft refueling supervisor and the fuels equipment operator. The hot pad supervisor will have a locally developed checklist designating his specific duties, responsibilities, and range of aircraft positions as a supplement to the specific aircraft supervisor’s servicing checklist. The hot pad supervisor must remain in full view of each aircraft refueling supervisor and fuels equipment operator.

Table 6-1. Hot Refueling System Safety Engineering Analyses

System	Notes
AIRCRAFT	
A-6 Pending Approval A/OA-10 AV-8 (Marines)	

Table 6-1. Hot Refueling System Safety Engineering Analyses - Continued

System	Notes
B-1B	
B-2A	
Beech King Air	
C/MC-12	
C-17	
C-27 (All Variants)	
C-130 (All Model)	
CASA-235	
DeHaviland DHC-6	
DeHaviland Dash 7	
E-2	
E-4B	
EA-6	
F-4	
F-14	
F-15	
F-16	
F-18, EF-18	
F-22	
F-35A/B/C	
HU-25	
CV-22, MV-22	
M-28	
PC-12/U-28	
Pilatus PC-6	
S-3	
UV-18B	1
X-32	
X-35	
X-45A	
X-47B	
HELICOPTERS	
Army/Marine AH-1, AH-64, CH-47, OH-58A through D, UH-1, UH-60, and H-6.	
AS-550/532	
Bell 212/412	
BO-105	
CH/HH/UH-46	
CH-53	2, 3
Cougar	
EC-725	
HH-1H, TH-1, UH-1N	3
HH-3	2, 4
HH/MH-53	2, 3, 5
H-60 (all variants)	3, 6
HH-65	
Lynx	
MI 8/17	
MI 24/25	
NH-90	

Table 6-1. Hot Refueling System Safety Engineering Analyses - Continued

System	Notes
Puma	
Super Puma	
Wessex	
FUELING SYSTEMS	7
ABFDS with ACE	
ABFDS with ACE (Engineering Air Services Inc (EASI))	
Army Aircraft Rapid Refueling Facility (ARRF) (Oasis)	*
Carter Pantograph	
GNY Pantograph	
GRU-17/E Pantograph	8 **
MH-2B/C Hose Cart	9 **
NVE Millennium Hydrant Hose Cart	
Forward Area Manifold (FAM) Cart and FAM 2000 Cart	
Fuels Operational Readiness Capability Equipment (FORCE)	
NVE MH-4 Millennium Hydrant Hose Cart	
Page AvJet Truck Hydrant Hose Truck	
R-9/R-14/R-25/R-26	***
R-11	**
R-11/HYMORE Truck	
R-12	**
R-14A/C	**
Type I Hydrant System	***
Type II Hydrant System	***
Type III Hydrant System	***
Type IV Hydrant System	***
US Army M-978 HEMTT with HTARS	10
U-2 Defueling Cart	
Fuel trucks designed to NFPA 407 requirements	
Edwards AFB portable and fixed Fuel Chillers and associated pantographs	

Table 6-1. Hot Refueling System Safety Engineering Analyses - Continued

System	Notes
Cla-Val Model 850 Pantograph	

[1] Must use only the aft filler port. The forward port is too close to the propeller. Users must make sure that center-of-gravity limitations are not exceeded when refueling only the aft tank.

[2] Fuel service includes CH-53 Auxiliary Tanks with Fuel Transfer by US Army FARE system.

[3] When refueling from an R-11 truck, the truck rotor separation distance can be reduced from 25 feet to 20 feet.

[4] R-9 fuel servicing trucks equipped with deadman controls are approved for H-3 hot refueling when using a reduced pumping pressure of 25 psi or less.

[5] R-9 fuel servicing trucks equipped with deadman controls are approved for H-53 hot refueling.

[6] Hot refueling of the Internal Auxiliary Fuel Tank System (IAFTS) or the aircraft using the open port/over-the-wing method is not authorized.

[7] Hot refueling operations are no longer authorized when using MIL-DTL-6615G refueling hose and/or SAE AS 38404 hose end couplers. Approved replacement hose to continue these operations is API/IP STD 1529, Grade 2/3, Type C, aviation fueling hose. Approved coupling replacements are internally expanded non-reusable hose end couplings meeting the design and performance specifications of API/IP STD 1529. (Exception to this requirement is hot refueling of E-4B aircraft due to distance between operating aircraft engine and single point refueling (SPR) receptacle locations.)

[*] Aircraft Rapid Refueling Facility (Oasis) located at Ft. Drum NY is approved for use.

[8] Position the GRU-17/E so that no portion of the pantograph is forward of any aircraft engine inlet during hot refueling of any aircraft (except A-10 where it can be under the wing).

[**] Approved for use when equipped with minimum API/IP STD 1529, Type C, Grade 2, hardwall aviation servicing hose assemblies with internally expanded forged brass or bar stock body couplings and brass or 300 Series stainless steel serrated ferrules, respectively.

[9] Must be equipped with a modified CLA-VAL rate-of-flow control valve to act as a hydraulic deadman.

[***] Approved for use with any Meyerinck, Cla-Val, OPW, Emco-Wheaton or Nova Group pantograph.

[10] Refueling hose pressure cannot exceed 25 psi.

6.8 HOT REFUELING EQUIPMENT OPERATOR (REO).

The REO (2F0X1) will assume a position at the refueling equipment and will observe the pressure gauges plus the hot pad and aircraft refueling supervisors and be constantly alert for a malfunction. Should a malfunction occur, the REO shall immediately shut down the fueling operation.

NOTE

For Panero Type I hydrant systems (with installed gauges, valves and meter only), the REO will monitor lateral control pit pressure gauges and crew chief will monitor pantograph.

6.9 HOT REFUELING SEQUENCE.

a. Fuel servicing equipment may be pre-positioned at hot refueling locations prior to arrival of the aircraft. Aircraft will not be hot refueled if the fuel jettison (dump) system was used on the previous flight unless it can be positively verified that the jettison valve(s) closed after the fuel jettison operation. Verification can be accomplished by observing cockpit indications (provided they show the true status of the jettison valves) or by physically observing the fuel to stop exiting the jettison outlet(s) upon termination of the jettison operation. If neither of these verification actions can be done, then the

aircraft must not be hot refueled until it undergoes at least one normal (cold) refueling operation to show that the jettison valves are closed.

WARNING

Aircraft will not be positioned such that jet exhaust is directed at another aircraft on the hot refueling pad.

CAUTION

Temperature sensitive substances (temp sticks) have caused damage to some aircraft brake assembly pressure plate antioxidant coatings. Refer to MDS Specific technical orders for guidance.

NOTE

For simultaneous hot refueling operations, aircraft will not enter the hot refueling pad unless it can immediately egress, if necessary. Fire department must be notified whenever hot refueling is to be accomplished. Refer to Paragraph 6.4 and Table 3-1.

b. A hot brake check will be performed. The A-10, C-5, C-17, C-130, C-141, E-4, F-15, and HH-60 aircraft are exempted because of the location, direction, and distance of the fuel vent outlets from the aircraft landing gear brake assemblies. The brake temperature should not exceed 750 °F. Temperature can be measured by temperature sensitive substances (temp sticks) or by infrared heat sensors. The aircraft hot brake checks will be accomplished prior to entering the hot refueling area. Aircraft with suspected or known hot brakes will not enter the hot refueling pad. The external fuel tanks will be safed prior to entering the hot refueling area.

c. Aircraft systems can be left operating, but do not allow transmitting on aircraft radar units nor HF radios.

d. The Hot Refueling Supervisor (HRS) will ensure the fuel servicing equipment outlet nozzle is connected and the deadman control valve is hand-held. The HRS will maintain intercom contact with the pilot and hot refueling crewman plus visual contact with the hot pad supervisor and fuels equipment operator. The HRS will observe the aircrew to ensure they maintain their hands up and/or out of the cockpit instrumentation area.

e. The fuels equipment operator will use standard checklists developed for preoperative inspection check of the fuel servicing equipment. Upon pressurization of the fuel servicing equipment, the equipment operator and all ground crewmen will check the system for malfunction or leaks. If no leaks are detected, the ground crewmen will signal the HRS that fuel transfer can begin.

f. On aircraft equipped with the capability to pre-check the refuel high level shutoff valves, the valves will be prechecked at the beginning of the hot refueling operation.

WARNING

Malfunction of any component of the fuel servicing equipment is cause to immediately shut down the equipment until the defect is repaired.

g. When the fuel servicing is completed, the aircraft fuel servicing supervisor will advise the pilot that the single point nozzle and bond wire have been disconnected. The aircraft HRS will then marshall the aircraft out of the area.

6.10 EMERGENCY PROCEDURES.

NOTE

- Emergency procedures will be outlined in locally developed checklists if such procedures are not included in specific aircraft checklist.
- Fire department should advise pilot when to abandon aircraft. This is to avoid having the pilot abandon the aircraft at the wrong time, e.g., jumping into a fuel fire.

a. Hot refueling operations may take place in HAS/PAS, hot refueling pads, or revetment areas. If a fire or fuel leak occurs, the following actions must be initiated immediately:

(1) Stop fuel flow.

(2) Stop aircraft engines.

(3) Notify the fire department.

(4) Evacuate all personnel other than fire guard(s).

(5) If leaking: Designated fire guard(s) will stand by with the portable extinguisher nozzle in hand (or nearby to initiate installed system) until the fire department arrives.

(6) For fires: Designated fire guard(s) will attempt to extinguish the fire until the base fire department arrives or until munitions are engulfed in flame.

b. If a fire occurs at another location in the general proximity of the aircraft being hot refueled, the following actions will be initiated at the location without the fire:

(1) Stop fuel flow.

(2) Disconnect fuel nozzle, bond wire and intercom cable.

(3) Evacuate aircraft from the area.

(4) Designated fire guard(s) will assist in fire fighting operations until the aircraft rescue and fire fighting vehicle arrives.

6.11 AIRCRAFT TO AIRCRAFT REFUELING (HOT OR COLD).

Aircraft to aircraft ground refueling operations may be accomplished with or without the aircraft engines operating for combat, simulated combat, and training operations. This procedure permits the rapid refueling of aircraft or helicopters in a tactical, forward operating area. These operations also provide a means of fueling an aircraft where appropriate fuel is not available. Fuel is supplied from aircraft internal fuel tanks with pumps powered by ground power units, aircraft power units, or operating aircraft engines. These operations present hazards which are not normally encountered in other fueling operations. Personnel involved in these operations must have:

a. A thorough knowledge of the aircraft fuel systems and fueling equipment used in the operation.

b. A thorough knowledge of and observe all safety procedures.

c. A thorough knowledge of and follow the sequential steps for the operation.

d. Undergone certification per command directives.

6.12 HOT (ENGINES RUNNING).

Aircraft to aircraft ground refueling will not be performed unless aircraft technical order guidance, checklists, and appropriate fueling system checklists are available. Aircraft will not be fueled without qualified and certified personnel. Servicing crewmembers include aircrews and/or ground support personnel. These operations will not be performed until SSEA validated and approved procedures have been accomplished on the aircraft, fueling system, and support equipment. The SSEA requires HQ AFMC/SES approval. Refer to Table 6-2 for these aircraft and fuel systems that have been approved for aircraft to aircraft fueling operations. Any deviation from this policy will be approved by HQ AFMC/SES. In those cases where combat or emergency situations require the use of aircraft to aircraft refueling, the MAJCOM commander may authorize deviations from this policy. Refer to Table 3-1 for fire protection requirements.

6.13 MAJCOM DIRECTIVES.

Each MAJCOM involved in aircraft to aircraft ground refueling will publish directives regarding specific procedures for accomplishing the operation. When hot refueling involves the resources of more than one command, the approval of each affected MAJCOM is required. A MAJCOM certification team, composed of safety, fuel servicing (when appropriate), aircraft maintenance (when appropriate), operations, fire protection and liquid fuels engineering (when appropriate) will certify individual installations for these servicing operations on a case by case basis. An on-site evaluation is not always required. Specific items to be included in the MAJCOM Directive are:

a. Procedures for certifying the site to be used for the fueling operation.

b. Procedures for certifying and training personnel involved in the fueling operation.

c. Define responsibilities of various functional agencies to include establishment of the MAJCOM OPR.

d. Other information necessary to assure a successful fueling operation is accomplished.

Table 6-2. Aircraft to Aircraft Refueling System Safety Engineering Analyses

Provider	Receivers
B-1B*	B-1B*
C-5A/B	H-1
C-17	All aircraft listed as receivers in this table.
C-130*	C-130*
	H-1/H-3*/H-53*
	H-60 (all variants)
	Army helicopters approved for hot refueling
C-130N/P*(Drogue)	H-3* (Probe)
CASA 212	Aircraft approved for hot refueling
CASA 235	Receiver approved for hot refueling
Cessna 208	Aircraft approved for hot refueling
C-141*	C/HC/MC-130*
	H-1/H-3*/H-53*
	H-60 (all variants)
	Army helicopters approved for hot refueling
H-53*	H-1/H-3*/H-53*

Table 6-2. Aircraft to Aircraft Refueling System Safety Engineering Analyses - Continued

Provider	Receivers
	H-60 (all variants)
	Army helicopters approved for hot refueling
EC/RC-135*	EC/RC-135
KC-10*	Senior Crown
KC-135A*	KC-135A
KC-135D/E/R*	KC-135D/E/R
KC-135T	Senior Crown/Senior Year

NOTE

- All tanker aircraft listed in Paragraph 6.17 are also approved providers in this table. All receiver aircraft listed in Paragraph 6.17 are also approved receivers in this table.
- An R-9/R-11 fuel servicing vehicle equipped with a deadman control may be used as a fuel source/receiver during training sessions for operations involving aircraft other than AMC Tankers (KC-135 Series and KC-10).
- C-5A/B aircraft may be used to cold refuel US Army helicopters.
- C-17, C-130, C-141, and H-53 aircraft may be used to hot refuel US Army helicopters approved by the US Army for hot refueling.
- R-9/R-11 fuel servicing trucks equipped with deadman controls are only approved for H-3 and H-53 hot refueling when using a reduced pumping pressure of 25 psi or less.
- A Forward Area Manifold (FAM) cart may be used between any approved provider aircraft and any approved receiver aircraft provided the servicing hoses are fully extended in all directions.

* Engines may be operating.

6.14 FUELS SERVICING USING THE AERIAL BULK FUELS DELIVERY SYSTEM (ABFDS) WITH ALTERNATE CAPABILITY EQUIPMENT (ACE).

Aerial bulk fuel delivery systems that are equipped with filter separators, dispensing hoses, fuel nozzles and hose end pressure regulators, ACE, are permitted to service aircraft directly from the cargo aircraft (C-17, C-130, or C-141). The normal fuel servicing members involved in this operation are two 2F0X1 fuel specialists accompanying the fuel system, and certain aircrew members from the cargo (tanker) aircraft. Procedures for this operation are provided in aircrew checklists and TO 37A9-3-11-1CL-1. Use of this equipment is restricted to combat, simulated combat, and training operations as directed by the MAJCOM. These operations will not be performed until SSEA evaluated and approved procedures have been accomplished on the aircraft, fueling system, and support equipment. The SSEA requires HQ AFMC/SES approval. Refer to Table 6-3 for those aircraft that have been approved for hot ABFDS with ACE fueling operations. Any deviation from this policy shall be approved by HQ AFMC/SES. In those cases where combat or emergency situations require the use of ABFDS with ACE to aircraft refueling, the MAJCOM commander may authorize a deviation from this policy. Refer to Table 3-1 for fire protection requirements. Personnel performing this operation must have:

a. A thorough knowledge of the aircraft and fuels servicing equipment involved in the operation.

b. A thorough knowledge of and follow all safety procedures.

c. A thorough knowledge of and follow the sequential steps of the operation.

d. Undergone certification per command directives.

6.15 MAJCOM DIRECTIVES PROCEDURE.

Each MAJCOM involved in ABFDS with ACE to aircraft ground refueling will publish directives regarding specific procedures for accomplishing the operation. When hot refueling involves the resources of more than one command, the approval of each affected MAJCOM commander is required. A copy of each MAJCOM commander's approval will be furnished to HQ USAF/ILS and the aircraft system manager/director. Specific items to be included in the MAJCOM directives are:

a. Procedures for certifying and training personnel involved in the fueling operation.

b. Defined responsibilities of various functional agencies to include establishment of the MAJCOM OPR.

c. Any other information necessary to assure a successful fueling operation is accomplished.

Table 6-3. ABFDS with ACE Refueling System Safety Engineering Analyses

Provider Aircraft	Receiver Aircraft	Hot	Cold
C-17/C-130/C-141 ABFDS with ACE Equipped Aircraft (These aircraft may have their engines operating)	A/OA-10	X	X
	C-130	X	X
	C-141		X
	F-15		X
	H-1		X
	H-3	X	X
	H-53	X	X
	H-60 (all variants)	X	X
	Army helicopters approved for hot refueling	X	X

6.16 HOT DEFUELING.

Rapid defueling and wet wing defueling operations are considered hot defueling operations whenever the provider/source/tanker aircraft has at least one engine running. Hot defueling can be done with all support equipment that has been approved for hot refueling. Any aircraft that is approved as a Forward Area Refueling Point (FARP) tanker aircraft is also approved for hot defueling operations.

6.16.1 Rapid Defueling. Rapid defueling reduces time and provides a means to rapidly off load fuel from aircraft at a higher flow rate than defueling systems and equipment are capable of providing. This is accomplished by operating one outboard aircraft engine or external hydraulic power cart, using on-board fuel transfer pumps and bypassing the defuel pumps installed in the fuel servicing systems. Rapid defueling presents hazards, which are not normally encountered in normal defueling operations. The following special precautions and instructions shall be followed when rapid defueling:

a. Rapid defueling shall not be accomplished until a SSEA is performed on the aircraft and fueling systems. C-130, KC-135, and EC/RC-135 aircraft have been approved for rapid defueling into Type I, Type II (Modified), Type III hydrant systems, all approved pantographs, R-9/11 and R-12 hydrant trucks, and R-14, MH-2 hose and R-25 carts.

b. All rapid defueling ground crew members will be certified to perform rapid defueling operations by qualified trainers/supervisors. An entry will be made in the individual's AF Form 623 on either the Career Field Education and Training Plan (CFETP) or other prescribed document, upon initial qualification, and annually thereafter in the applicable Management Information System (MIS).

NOTE

At installations where aircraft parking space is limited and hydrant fuel pit spacing will not permit 50-foot aircraft wing tip clearance, the (aircraft to aircraft) wing tip separation can be reduced to a minimum of 35 feet. However, whenever a distance of less than 50 feet (wing tip to wing tip) is maintained an aircraft rescue and fire fighting vehicle must be at the aircraft during rapid defueling operations.

c. Intercom between the rapid defueling supervisor and the fuels equipment (2F0X1) operator shall be maintained during the entire operation.

d. The fuels operator will assume a position at the hydrant pit, hose cart or defueling unit to monitor the equipment for malfunctions. Should a malfunction occur, the rapid defueling operation will be stopped immediately.

WARNING

Personnel shall not be stationed on top of the servicing unit during rapid defueling operations.

e. Rapid defueling shall be conducted in accordance with published aircraft and fuels equipment technical orders/checklists.

6.16.2 Wet Wing Defueling. Wet wing defueling is a similar operation for providing fuel in a forward operating area. Rather than an aircraft or helicopter as the receiver, fuel is transferred into US Army Forward Area Refueling

Equipment (FARE), Army tank truck, or 500 gallon sealed drums at a fuel system supply point. This operation provides the rapid supply of fuel needed for initial support of intense short duration conflicts and is accomplished with four aircrew members. Personnel involved will be trained and certified as required by MAJCOM directives. The US Army will furnish all required fuel transfer equipment (including the interface equipment between the aircraft and the US Army fuel system supply point). Fire protection (Army supplied) for the operation is, as a minimum, four dry chemical fire extinguishers of 80 BC rating. For C-5 aircraft, wet wing defueling is accomplished using electrical power from either a USAF-supplied GPU or the aircraft APU. For C-130 aircraft, electrical power is supplied from either a GPU or by running number 1 and 2 engines. For C-141 aircraft, electrical power is supplied from either a GPU or the aircraft APU. For KC-135E aircraft (after TCTO 1388, 180L APU), electrical power can be supplied from either a GPU, by running an outboard engine, or the 180L APU. Refer to Table 6-4 for aircraft approved for wet wing defueling.

6.16.3 Aircraft to Aircraft Operations. During aircraft to aircraft refueling operations, if the provider aircraft has at least one engine running, it is considered a hot defueling operation.

Table 6-4. Wet Wing Defueling System Safety Engineering Analyses

Provider	Receivers
C-5A/B	US Army FARE/Truck/Drum; R-9, R-11, and R-14 Trucks
C-17	US Army FARE/Truck/Drum; R-9, R-11, and R-14 Trucks
C-27	US Army FARE/Truck/Drum; R-9, R-11, and R-14 Trucks
C-130	US Army FARE/Truck/Drum; R-9, R-11, and R-14 Trucks
C-141	US Army FARE/Truck/Drum; R-9, R-11, and R-14 Trucks
KC-10	US Army FARE/Truck/Drum; R-11, and R-14 Trucks
KC-135	US Army FARE/Truck/Drum; R-11, and R-14 Trucks

6.17 FORWARD AREA REFUELING POINT (FARP) OPERATIONS.

FARP operations involve a tanker aircraft and one or more receiver aircraft. The tanker aircraft will typically land in a forward area and deploy ground refueling equipment, including hoses and an optional Forward Area Manifold (FAM) cart. Aircraft crewmembers will lay out the equipment to service fuel bladders, vehicles, or arriving aircraft (one to six, depending upon the operation). Qualified Hose Deployment Personnel (HDPS) will service each receiver using the tanker-supplied fueling equipment. A qualified HRS will operate the FAM cart (if used), supervise the operation, and be on intercom contact with the tanker aircrew. Engines will be operating on the tanker and receiver aircraft/vehicles. A separate SSEA is required to approve each aircraft as a FARP tanker or receiver. The following aircraft are approved tanker aircraft: C-5, C-17, C-27, C-130, C-141, CESSNA 208, CASA 212, and the CASA 235. The following aircraft are approved receiver aircraft: PC-12/U-28, Bell 212/412, AS 550/532, EC-725, C-130J, BO-105, NH-90, CH-47, MC-12, Cessna 675 (engine not operating), Cessna UC-35 (engine not operating) M-28, Cougar, and Super Puma. H-1, AH-1, H-6, H-53, OH-58, H-60, AH-64, UV-18B, WESSEX, PUMA, LYNX, MI-8/17, MI 24/25, PILATUS PC-6, DE-HAVILAND DHC-6, BEECH KING AIR, CASA 235, A-10, C-130, MERLIN, and the V-22 aircraft. Any approved tanker aircraft can FARP any approved receiver aircraft.