BY ORDER OF THE SECRETARY OF THE AIR FORCE

AIR FORCE OCCUPATIONAL SAFETY AND HEALTH STANDARD 91-38

1 SEPTEMBER 1997

Safety

HYDROCARBON FUELS-- GENERAL

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OPR: HQ AFSC/SEGS (SMSgt Pennie Hardesty)
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The criteria in this standard are the Air Force's minimum safety, fire prevention, and occupational health requirements for all Air Force hydrocarbon fuels operations, including Base Fuels Laboratories. Major commands (MAJCOM), direct reporting units (DRU), and field operating agencies (FOA) may supplement this standard when additional or more stringent safety, fire prevention, and health criteria are required. Refer to Air Force Instruction (AFI) 91-301, *Air Force 0ccupational and Environmental Safety, Fire Prevention, and Health (AFOSH) Program*, for instructions on processing supplements or variances. Report conflicts in guidance between this standard, federal standards, or other Air Force directives through MAJCOM, DRU, or FOA ground safety offices to Headquarters, Air Force Safety Center, Ground Safety Division, Safety Engineering and Standards Branch, (HQ AFSC/SEGS), 9700 G Avenue, SE, Kirtland AFB NM 87117-5670.

This standard addresses key hydrocarbon fuels criteria, references other Air Force directives that cover specific aspects of hydrocarbon fuels, and implements pertinent portions of regulatory Occupational Safety and Health Administration (OSHA) Standards Title 29 Code of Federal Regulations (CFR) 1910.104, *Oxygen,* 1910.106, *Flammable and Combustible Liquids,* 1910.1025, *Lead*, 1910.1028, *Benzene,* and 1910.1200, *Hazard Communication.* It includes general safety information applicable to hydrocarbon fuel operations, including sampling and fuel laboratory analysis, and applies to hydrocarbon fuels in Federal Stock Classes (FSC) 9130 and 9140, including hydrocarbon missile and rocket fuels. It does not apply to missile and rocket fuels or oxidizers in FSC 9135. The standard applies to all US Air Force organizations, including US Air Force Reserve personnel and when Air National Guard personnel are on federal service.

Management and safety inspections of organizational fuel tanks are outlined in AFI 23-204, *Fuel Tanks.* This standard provides criteria for fuels laboratory personnel when drawing samples and performing laboratory analyses of fuels.

Technical Order (TO) 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding,* contains specific information on aircraft fuel servicing and related operations. Fuels management and related occupational safety, fire prevention, and occupational health requirements are addressed in AFI 23-201,

Fuels Management. Air Force Manual (AFMAN) 85-16, *Maintenance of Petroleum Systems,* provides specific guidance on maintenance of petroleum systems.

SUMMARY OF REVISIONS

Administrative changes have been made to update this standard to electronic format. Paragraphs have been renumbered and references updated as required. Updated adverse weather procedures are included at paragraph 2.7. A glossary of references, abbreviations, acronyms, and terms is provided at attachment 1. Minor changes are annotated by a | .

Current design criteria for new facilities and modifications or renovations of existing hydrocarbon fuel facilities are found in AFI 32-1024, *Standard Facility Requirements*, and Military Handbook (MIL-HDBK) 1008, *Fire Protection for Facilities Engineering, Design, and Construction.* ***NOTE:*** AFOSH 127-series standards are being converted to 91-series standards and the 161-series to 48-series standards. However, not all standards have been converted as of the effective date of this standard. To help you locate these documents, references to AFOSH standards are stated in the updated series and standard number, with the outgoing series and standard number stated as "formerly designated as" in the references section of attachment 1.

Chapter 1

HAZARDS AND HUMAN FACTORS

1.1. General Information . All hydrocarbon fuels discussed herein are liquids ranging in color from clear to straw-yellow or a very pale blue. Certain gasolines, particularly aviation (commercial) gasoline containing tetraethyl lead, have certain dyes added to identify the grade of product. TO 42B-1-1, *Quality Control Fuels and Lubricants***,** identifies hydrocarbon fuels and provides their military specifications. Hydrocarbon fuels vary in volatility according to their composition. They are fat solvent, which accounts for their skin-irritating properties. Fuels used primarily in the ground environment such as gasoline, kerosene, diesel, and fuel oils possess similar properties and characteristics. These ground fuels warrant the same degree of attention and safety afforded aviation fuels (refer to attachment 2 for more on aircraft fuel classifications).

1.2. Chemical Properties . All hydrocarbon fuels are insoluble in water. However, they are soluble in many organic components and are, themselves, excellent solvents for many organic materials. Hydrocarbon fuels are chemically stable and insensitive to shock. Some of the dyes used to identify various gasoline products are light-sensitive and these fuels must be handled with minimum exposure to light to prevent change of color. All US Air Force fuels demonstrate good thermal stability over a wide range of ambient storage temperatures, but exposure to a wide range of temperatures or prolonged storage will accelerate oxidation and the formation of gum and sediment. Hydrocarbon fuels react with strong oxidizers, and at higher pressures and (or) temperatures this reaction is accelerated.

1.3. Ignition Hazard . Oxygen is present in the atmosphere and comprises approximately 21 percent by volume of the total atmospheric air. It can be present locally at concentrations considerably greater than 21 percent due to leaks in oxygen gas storage cylinders or cryogenic generators. Atmospheric air containing 21 percent oxygen will support combustion, but at concentrations of 16 percent or less, combustion will not be self-sustaining. Hydrocarbon fuel vapors by volume create an explosive atmosphere (lower explosive limit 1 percent, upper explosive limit 7 percent). Explosive atmospheres can readily be ignited by ignition sources such as electric sparks, static electricity, or open flame. The ignition susceptibility of the fuel varies with flashpoint, pressure, and the specific type of fuel. These classes are defined in table 1.1. Hydrocarbon fuel fires may be both air-supported and other-oxidizer-supported. The rate of fuel evaporation increases with increases in temperature. A mixture within lower explosive limits is too “lean” to burn and a mixture above the upper flammable and (or) explosive range is too “rich” to burn.

1.4. Toxicity. Hydrocarbon fuels are moderately skin irritating and repeated contact can cause scaling, fissuring of the skin, and blistering. Inhalation causes irritation of the upper respiratory tract; central nervous system stimulation followed by depression of varying degrees ranging from dizziness, headache, and in coordination to anesthesia, coma, and respiratory arrest. Aspiration causes severe lung irritation with coughing, gagging, and rapidly developing pulmonary edema; later, bronchopneumonia and pneumoconiosis. Ingestion causes irritation of mucous membranes of throat, esophagus, and stomach followed by depression of the central nervous system.

1.5. Exposure to Aromatic Fuel Additives. As a general rule, the higher the aromatic content, the more toxic the fuel becomes. The two principal toxic additives in US Air Force fuels are benzene and tetraethyl lead. Benzene is present in both gasoline-based and kerosene-based fuels while tetraethyl lead is usually

present only in gasoline-based fuels. ***NOTE:*** JP-4, although classified as a gasoline-based fuel, does not contain tetraethyl lead.

1.5.1. All fuels contain benzene to some degree (0.1 to 5 percent by volume). Aviation gasoline usually contains higher concentrations of benzene than does JP-4 or heavier distillate fuels; however, the toxicity of benzene is such that even when present in fuels in low concentrations, it must be considered the controlling hazard during fuel handling. This is particularly true in confined spaces such as petroleum storage tanks. AFOSH Standard 48-8, *Controlling Exposures to Hazardous Materials***,** discusses the hazards and precautions required during potential benzene exposures. When required, laboratory analysis of benzene can be conducted by the fuels laboratories listed in TO 42B-1-1. AFOSH Standard 91-25, *Confined Spaces***,** contains specific guidance for entering confined spaces.

1.5.2. Tetraethyl lead can enter the human body via three routes: absorption through the skin, inhalation of vapors, and ingestion. Exposure to the petroleum product or contact with petroleum byproducts, including petroleum sludges and petroleum tank scale and rust can result in tetraethyl lead entering the body. Exposure to sludges, scale, and rust is common during tank and strainer cleaning operations. Tetraethyl lead is highly toxic to the central nervous system. The amount present in hydrocarbon fuels is low and the quantity of lead in the fuel itself does not constitute a significant health hazard. However, in some circumstances such as in fuel storage tanks, the tetraethyl lead concentration may be greater.

1.5.3. AFOSH Standard 48-8 provides the basic guidance for establishing an exposure control program including exposure assessments, health risk assessments, and occupational physical requirements.

1.6. Asphyxiation and Confined Space . Hydrocarbon fuel vapors will displace oxygen from enclosed spaces and pits and may create an environment that is incapable of supporting life. (AFOSH Standard 91-25.)

Table 1.1. Classifications of Flammable and Combustible Liquids.

Designation Class	Subclass	Definition
Flammable	Class I	Any liquid with flashpoint below 100 degrees Fahrenheit (F).
	Class IA	Includes liquids having flashpoints below 73 degrees F and having a boiling point below 100 degrees F.
	Class IB	Includes liquids having flashpoints below 73 degrees F and having a boiling point at or above 100 degrees F.
	Class IC	Includes liquids having flashpoints at or above 73 degrees F and below 100 degrees F.
Combustible	Class II	Includes those liquids with flashpoints at or above 100 degrees F and below 140 degrees F.
	Class III	Includes those liquids with flashpoints at or above140 degrees F.
	Class IIIA	Includes those liquids with flashpoints at or above 140 degrees F and below 200 degrees F.
	Class IIIB	Includes those with flashpoints at or above 200 degrees F.

Chapter 2

GENERAL REQUIREMENTS

2.1. Sources of Ignition:

2.1.1. General . Ignition under controlled conditions causes combustion of fuels for their intended purpose. It is the unexpected and unwanted ignition of fuels that causes accidental fires and explosions with resultant property damage, injury, and (or) loss of life. Rigid precautions will be taken to prevent the ignition of flammable vapors. Possible sources of ignition at US Air Force work and storage areas include open flames such as matches and cigarette lighters, cutting and welding sparks, static electricity, and lightning. Support equipment being operated in any fuels area will meet the requirements of AFMAN 24-306, *Manual for The Wheeled Vehicle Driver***,** and TO 00-20B-5, *USAF Motor Vehicle and Vehicular Equipment Inspection.*

2.1.2. Static Electricity. When hydrocarbon fuels flow through hoses or pipe systems, they become electrostatically charged. Electrostatic charges can exceed 20,000 volts and contain sufficient electrical energy to arc or spark when touched. A conductivity additive is used in both JP-4 and JP-8 fuel to minimize static buildup during fuel flow.

WARNING: The additive DOES NOT ELIMINATE the accumulation of static electricity in fuel flowing through hoses or pipes.

2.2. Sources of Static Electricity:

2.2.1. The filter-separator unit is a static electricity generator because the flow of fuel through tiny openings (filtration) can produce very high electrostatic charges on fuels. A relaxation period of at least 30 seconds after flow stops should be provided downstream of any filter before removing bonding connections, etc.

2.2.2. Aircraft refuelers and commercial petroleum transport vehicles accumulate significant electrostatic charges during filling operations. A primary source of electrostatic charge generation is the filter separator installed on the bottom and (or) top loading fillstand. The second charging mechanism results from movement of fuel through wire screens or line strainers having small openings. Screens with a pore size less than 300 micron (50 mesh per inch) are capable of charge generation that could be hazardous in some circumstances. The third charging mechanism results from movement of fuel through piping or hose. Proper grounding and bonding are important.

2.2.3. Filling refuelers or permanent fuel storage tanks from an overhead spout should be avoided whenever possible, since this method has a high potential for building electrostatic charges as the fuel free-falls through air and agitates the fuel in the tank.

2.2.3.1. If using an overhead spout, submerge the filling nozzle (if possible) to reduce static generation.

2.2.3.2. Bottom loading refuelers have largely replaced the overhead filling method to minimize fuel turbulence. For this reason, ensure permanent fuel storage tanks, both underground and aboveground, are designed for bottom loading.

2.2.3.3. Regardless of the filling method used, danger signals (such as crackling and hissing sounds) indicate the presence of very dangerous levels of static electricity. If this occurs, immedi-

ately stop filling operations and evacuate personnel until the static charge has dissipated. Identify and eliminate the cause of the static buildup before resuming operations.

2.2.4. Support equipment can develop charges of static electricity while parked due to the movement of dust particles and air currents or during periods of electrical storm activity in the vicinity.

2.2.5. Grounding and (or) bonding requirements are contained in AFMAN 85-16, TO 00-25-172, TO 42B-1-1, and TO 37-1-1, *Operation, Inspection, and Maintenance of Permanently Installed Fuel Storage and Dispensing Systems.*

2.2.5.1. Remove or replace all static grounds with resistances of more than 10,000 ohms.

2.2.5.2. Repair and retest damaged static grounds for resistance values. Static grounds do not need to be tested periodically after values are permanently recorded.

2.3. Fuel Spill Classifications . Fuel spill classification and emergency procedures are described in TO 00-25-172. Cleanup procedures will be established by the installation Environmental Coordinator.

2.4. Training of Personnel:

2.4.1. AFOSH Standard 48-21, *Hazard Communication,* contains the specific training requirements for personnel engaged in activities that involve the handling or use of hazardous materials. Since most petroleum products are classified as hazardous materials, employees working with fuels require training, per requirement in AFOSH Standard 48-21.

2.4.2. Ensure individuals operating in environments where petroleum products are present are instructed in the hazards of static electricity.

2.4.3. Make sure fuels handling personnel are trained in fire prevention and protection as it relates to their particular duties.

2.4.4. Operations involving the handling, transfer, or storage of hydrocarbon fuels normally require the presence of a minimum of two persons who are fully knowledgeable in Air Force safety and operational procedures. Refer to AFI 23-201 for definitive guidance on the two-person policy.

2.4.5. Ensure personnel are trained how to minimize the possibility of hydrocarbon fuels and propellant oxidizers being spilled in the same area. If such a spill does occur and if the oxidizer is water soluble, flood the oxidizer with water to dilute it and help reduce the hazard of an explosion or fire. Contact the installation fire department whenever a fuel spill or an oxidizer spill occurs.

2.5. Petroleum Storage Tank Entry . AFMAN 85-16 covers this subject in detail and shall be used as the source of definitive guidance on all tank entry tasks. Additionally, AFOSH Standard 91-25 addresses confined space entry.

2.6. Work Areas and Storage Rooms. Design, construction, and layout of such areas are addressed in MIL-HDBK-1008, in construction drawings, and in functional manuals. The following minimum safety features shall be included at any location where petroleum products are handled or stored:

2.6.1. Refer to AFOSH Standard 91-32, *Emergency Shower and Eyewash Units,* for requirements and recommended types of emergency showers and (or) face and eyewash units for fuels handling.

2.6.2. Consult AFOSH Standard 91-31, *Personal Protective Equipment,* for recommended types of rescue harnesses, lifelines, and personal protective clothing and equipment to use for assigned tasks. Additional guidance for respirator use is contained in AFOSH Standard 48-1, *Respiratory Protection Program.*

2.6.3. Ensure fire suppression systems are approved per requirements in MIL-HDBK-1008 (see AFOSH Standard 91-56, *Fire Protection and Prevention,* for guidance). In addition, consult the installation fire department.

2.7. Adverse Weather Conditions:

2.7.1. The base weather station (BWS) is responsible for making the initial notification to predetermined support agencies of adverse weather conditions. Adverse weather conditions include: strong surface winds, heavy rain, freezing precipitation and thunderstorms(i.e., frequent dangerous lightning, and damaging winds, heavy rain and hail).

2.7.2. General lightning safety for all AF activities and operations:

2.7.2.1. Whenever lightning is detected or observed within the immediate vicinity of any activity or operation the following precautions should be taken:

- Do not go out of doors or remain out unless it is absolutely necessary.
- Seek shelter as follows:
  - Dwellings or other buildings that are protected against lightning;
  - Protected underground shelters;
  - Large metal framed buildings;
  - Enclosed automobiles, buses, and other vehicles with metal tops and bodies;
  - Streets that may be shielded by nearby buildings.

2.7.2.2. Certain locations are extremely hazardous during thunderstorms and should be avoided:

- Open fields;
- Near wire fences, overhead wires, and railroad tracks;
- Under isolated trees; and
- Near electrical appliances, telephones, plumbing fixtures, and metal or electrically conductive objects.

2.7.3. Each Air Force installation will develop a local procedure to ensure that key personnel and agencies involved in high weather risk activities and operations are notified according to the base weather support plan. Normally, these agencies are those having aircraft, petroleum/oil/lubricant (POL) facilities, open air work and recreational activities, and underground utilities work. Key personnel, in turn, will advise all on-duty supervisors to take proper precautions and timely actions.

2.7.4. Each installation will employ a lightning safety program with a two-tiered notification system to minimize personnel exposure to lightning hazards.

2.7.4.1. A *Lightning Watch* is in effect 30 minutes prior to thunderstorms being within 5 nautical mile (nm) radius of any predetermined location or activity as forecast by the BWS.

NOTE: Lightning is a direct product of a thunderstorm. During a Lightning Watch accomplish the following:

- Operations or activities may continue, however all personnel must be prepared to implement Lightning Warning procedures without delay.
- Be alert for any lightning activity, to include audible thunder, and advise supervisory personnel of any observations.

2.7.4.2. A *Lightning Warning* is in effect whenever any lightning is occurring within 5 nm radius of the predetermined locations and activities. Personnel in affected locations or engaged in affected activities will take the following actions:

- Cease all outside activity and seek shelter. Recommended locations that provide safe shelter and locations to avoid are listed in paragraph 2.7.2.
    - If lightning does not occur within 5 nm at the valid (forecast) time of the Lightning Watch then BWS will reassess the Lightning Watch and amend as needed. Lightning warnings will be canceled when the thunderstorms have passed beyond the 5 nm radius of the location or activity. A Lightning Watch will not be canceled if there is potential for more thunderstorms within 30 min.
    - All aircraft fuel service maintenance activities (including liquid oxygen [LOX] servicing) will cease whenever a Lightning Warning is in effect. Automatic service stations will be placed in the manual operation mode.

EXCEPTIONS: Commercial and Department of Defense (DOD) pipeline receipts, issues from military service stations or base exchange (BX) service station, vehicle movements (including refuelers), and pipeline transfers (including bulk storage).

2.8. First Aid. Personnel will take the following steps if hydrocarbon fuels are splashed or spilled onto them:

2.8.1. Remove contaminated clothing as soon as possible and wash affected skin areas with soap and water. Thoroughly air and launder contaminated clothing before it is worn again. Do not place contaminated clothing in lockers or other confined spaces. Hang clothing in a safe area away from fire and heat and allow it to air dry.

2.8.2. If fuel is splashed into the eyes, immediately flush the eyes with water continuously for at least 15 minutes, then seek medical attention. Refer to AFOSH Standard 91-32 for information on emergency shower and eyewash units.

2.8.3. If fuel is swallowed, do not induce vomiting. Seek medical assistance as soon as possible.

2.8.4. See attachment 3 for additional information on safety around hydrocarbon fuels.

2.9. Finger Rings and Jewelry:

2.9.1. The potential for catching, snagging, and pulling of rings and jewelry exists in and around fueling operations. Because of this, controls shall be exercised over the wearing of rings, watches, bracelets, necklaces, and other items of jewelry. Whenever possible, jewelry will be removed before entering a fuel operations area.

2.9.2. Supervisors are responsible for identifying those tasks where wearing a ring is prohibited, e.g., tasks that involve climbing on fuel trucks or on tanks where workers could catch their rings during a slip or fall. If warranted by local conditions, supervisors may elect to prohibit the wearing of rings in all petroleum workcenters in lieu of identifying individual tasks. If this is done, supervisors shall include this information as part of their employee briefing required by AFI 91-301. The installation ground safety personnel may be contacted for assistance and will review these procedures for adequacy during annual inspections.

WARNING: The practice of placing tape over rings is insufficient protection and does NOT satisfy the requirements for removing the ring.

Chapter 3

FUEL STORAGE SYSTEMS

3.1. Safety Features . New construction, alteration, and (or) modification of petroleum facilities will conform to applicable Air Force specifications and directives. Existing facilities, unless hazardous, are not required to meet current Air Force specifications or directives, until a modification or alteration is planned. Alterations may be affected when existing facilities are uneconomical to maintain or hazardous to operate. Attention should be given to the special features below.

3.1.1. Access . Where necessary, pit covers will be altered or replaced to provide free and unobstructed access. A survey should be made to determine pits essential to the operation and control of the system. Existing pits which are not essential, or that can be made nonessential, should be filled with sand to eliminate vapor hazards. Essential pits will be kept clean, dry, and vapor-free and pit covers will be closed except when work is being done in the pit.

3.1.2. Ventilation:

3.1.2.1. Adequate ventilation will be provided for below-grade pumphouses and deep pits to prevent accumulation of explosive vapor hazards. Opening the pit covers normally provides sufficient ventilation for shallow pits and hand holes (generally used for maintenance purposes only).

3.1.2.2. Entry into enclosed spaces and pits where oxygen may be displaced by hydrocarbon fuel vapors will be according to master entry plans and permits issued in compliance with AFOSH Standard 91-25. The installation ground safety staff or Bioenvironmental Engineer may be contacted for specific ventilation requirements.

3.1.3. Drainage. Where water from seepage, flooding, or other causes is encountered in large pits, drainage by gravity or sump pumps will be provided. Hand pumps should be used to remove water from small pits. Drains from pits and (or) pumphouse floors will not be connected to sanitary or storm sewer systems.

3.1.4. Piping System Identification. Piping systems will be color coded to aid in identifying the contents of piping in storage areas. As a minimum, yellow will be used as a primary warning for all flammable gases and liquids, and black and white will be used to print words of identification. Other specifications are provided in Military Standard (MIL-STD) 161F, *Identification Methods for Bulk Petroleum Products Systems Including Hydrocarbon and Missile Fuels***,** and AFOSH Standard 91-44**,** *Safety Color Coding, Labeling, and Marking for Piping Systems.*

3.2. Safety Procedures:

3.2.1. Bond fuel transport vehicles (tank trucks) to the offloading header to relax any static electricity charges generated during the handling operation.

3.2.2. Place a drip pan under the outlet of each railroad tank car or transport truck before the dust or outlet cap is removed, to collect any fuel that may have leaked through the main valve during transportation.

3.2.3. See paragraph 2.7. for adverse weather conditions safety procedures.

3.2.4. During transfer of fuel from all fuel sources into an off-loading header, check the receiving tank for sufficient ullage prior to beginning the transfer. Ensure the initial flow-rate does not exceed

3 feet per second and is maintained until the inlet of the tank is submerged. Allow a minimum waiting time of 30 minutes for electrostatic charges to dissipate before performing manual gauging or temperature measurement.

3.2.4.1. Make sure the gauging tape remains in contact with the gauging hatch, to provide an electrical bond and prevent electrostatic arcing.

3.2.4.2. Upon completion of gauging or temperature measurement, ensure the worker slowly removes the tape from the tank, maintaining contact between gauging hatch and tape.

3.2.5. Use danger signs in the following ways:

3.2.5.1. Place danger signs 50 feet in the front and rear of railroad tank cars or transport trucks prior to off-loading operations into bulk storage. These signs are not required during bulk off-loading operations at installation service stations; however, the installation Fuels Management Flight Chief may require special procedures for unique installations. In addition, signs are not required for off-loading operations within posted secured areas.

3.2.5.2. Ensure danger signs for the periphery of fuel storage areas are worded as follows: "No Open Flame or Ignition Source Beyond This Point." The signs will normally be placed on the security fence surrounding the area. In those instances where security fences are not provided, post signs 50 feet from the diked area or fuel vents of underground storage tanks, or as determined by the base civil engineer (BCE), in consultation with installation ground safety officials.

3.2.6. Provide adequate fire protection for fuel handling operations, as determined by the installation fire chief. Ensure required equipment is properly located before operations begin.

3.2.7. In order to protect personnel from fuel vapors and to lessen the hazards of static electricity, personnel should not be allowed on above-ground receiving tanks during filling operations or within 30 minutes thereafter.

3.2.8. Because flammable fuel air mixtures may be present, never use open flame or heating element to thaw frozen valves on tank cars to tank trucks.

3.2.9. Use a two-person policy during fuel receipts and transfers.

3.2.10. Include emergency shutdown procedures in all local procedures and checklists covering the movement of fuel.

3.2.11. After the element of a filter separator has been changed, slowly fill the vessel by partially opening the inlet and outlet valves to displace the entrapped air. The slower flow will reduce electrostatic charging of the fuel. Refer to TO 37-1-1, for complete details on filling filter separators after element change.

3.2.12. Before starting fuel transfer actions, establish communications (hot line, radio, telephone, etc.) between pipeline pump station, barge or tanker, and receipt location. To ensure emergency shutdown capability, provide communications throughout the entire receipt.

3.2.13. Keep the dike basin area free of vegetation. When possible, construct dikes according to MIL-HDBK-1008.

3.2.14. When tank water drains and dike drain valves are not in use, lock them closed.

3.2.15. During draining operations, watch floating roof water drains to ensure no fuel runs out with the water as the result of a leak in the drain pipe. When possible, secure roof water drains by lock upon completion of draining operations.

3.2.16. Provide adequate lighting in petroleum areas for safe and secure night operations (1-footcandle in general areas; 2-footcandles on catwalks). In classified areas, lighting fixtures and wiring must comply with the requirements of National Fire Protection Association (NFPA) 30, *Flammable and Combustible Liquids Code*.

3.3. Truck Fillstand Operations:

3.3.1. Position the fuel servicing vehicle so issue can be made without placing a strain on the fillstand components.

3.3.2. Set the vehicle parking brake and chock the rear wheels.

3.3.3. Bond the vehicle to the fillstand by connecting the vehicle conductor reels to a bonding receptacle on the fillstand. When a hose cart is used as a fillstand, the hose cart operator will bond the hose cart to the hydrant outlet piping. The refueling unit operator will bond the refueling unit to the hose cart.

3.3.4. Push the stop switch on the fillstand to ensure the transfer pump is not operating. This ensures the loading arm or hose is not pressurized prior to connecting the bottom loader assembly to the vehicle and will avoid a possible fuel spill.

3.3.5. When beginning filling operations, the operator will open appropriate fuel transfer valves, turn on the pump, and check for leaks. In addition, they will check the bottom loading automatic shutoff device during the beginning of the fill operation by pushing the test button on R-5, R-9, or R-11 refuelers during the first 500 gallons of fuel pumped into the vehicle.

3.3.6. A person need not be positioned on top of refueling vehicles during loading operations if the vehicles are equipped with a bottom loader and automatic shutoff.

3.3.7. When the filling operation is completed, disengage the fuel storage system nozzle from the vehicle and obtain required forms from the bulk storage operator. The operator will conduct a "walk-around" inspection, check for leaks, remove the ground cable and wheel chocks, and depart the area.

3.3.8. Make sure all fillstands are equipped with an emergency shutdown switch capable of stopping all associated transfer pumps in the event of a fire or other mishap. Identify the emergency switch and ensure all personnel are familiar with its location. Inspect the fillstand emergency shutdown switch during system checkout and activate it at least every 30 days to ensure proper operation. Make sure the emergency shutdown switch is located no closer than 25 feet from the fillstand.

3.4. Railroad Tank Car Operations. Unloading tank cars through bottom valve arrangement to installed bulk storage systems:

3.4.1. Isolate railroad tank car off-loading tracks (spur) from the main tracks and ground them. The off-loading header need not be grounded to the tank car since there is electrical continuity between the rail and tank car body. However, check the grounded railroad spur to ensure a resistance reading of 10,000 ohms or less (per paragraph 2.2.5).

3.4.2. If tank cars are being loaded with aviation fuels or Mogas at Air Force installations, bond the tank car to the loading facilities.

3.4.3. Insulate the railroad spur from the adjoining railroad track serving the rest of the installation by means of insulation blocks. Bond each of the rails on both sides of the track by electrical connectors. Connect the insulated and bonded tracks and ground them to the same grounding point with the piping at each unloading manifold. The insulating and bonding of the tracks ensure proper control and discharge of any static electricity buildup.

3.5. Fueling Equipment Safeguarding:

3.5.1. Areas where fuel servicing equipment is parked present the same explosive and safety hazards as bulk fuel storage facilities. The parking areas will be treated as above-ground fuels facilities and safeguarded accordingly.

3.5.2. A paved, flood-lighted area is required at each installation for parking of fuel servicing equipment. The following minimum criteria will be followed:

3.5.2.1. There will be at least two entry and (or) exit ways to provide means for rapid egress in the event a hazardous situation develops.

3.5.2.2. One hundred feet is the minimum separation between fueling vehicle parking areas and surrounding inhabited buildings. Fifty feet is the minimum separation distance for uninhabited buildings and taxiing aircraft.

3.5.2.3. At existing parking areas, the 100-foot requirement in paragraph 3.5.2.2. may be modified on the basis of local conditions, taking into consideration the size, nature, and importance of nearby exposed buildings. However, this separation distance should not be reduced below 50 feet.

3.5.2.4. A minimum separation of 25 feet center-to-center will be maintained between parked fueling vehicles in designated storage areas. Vehicles should be parked in single rows and should be capable of being driven into and out of parking positions in a single turn.

3.5.2.5. The vehicle parking areas will be designed with sufficient slope to control drainage. The surface will be paved. A smooth rigid surface is necessary for safe jacking of refueling units weighing approximately 28 tons. See AFOSH Standard 91-20, *Vehicle Maintenance Shops*, for additional guidance on refueler vehicle maintenance areas.

3.5.2.6. Sufficient and adequate fire fighting equipment (portable or wheeled units) will be available and strategically located within the confines of the parking areas as determined by the installation fire chief.

3.5.2.7. Danger signs will be placed on the fence surrounding the area and worded as follows: “No open flame or ignition source beyond this point.” At those installations where fencing is presently not erected, signs will be placed on the perimeter of the storage area. The number and separation distance of the signs will be determined by the installation fire chief.

Chapter 4

FUEL SERVICING OPERATIONS

4.1. Aircraft Servicing-General Precautions. Precautions will be taken to minimize the possible sources of vapors and eliminate ignition sources during any aircraft servicing operation whether it be by mobile or hydrant systems.

4.1.1. During any fueling or defueling operations, a fuel servicing safety zone (FSSZ) will be established, per TO 00-25-172.

4.1.2. All support equipment which is not required in fueling or defueling operations or in concurrent fueling, maintenance, or cargo-handling operations, will be moved outside the FSSZ. The equipment will be positioned so a clear path will be maintained to permit rapid evacuation of fueling vehicles and personnel in an emergency.

4.1.2.1. On flight lines with minimum aircraft separation (i.e., 10-15 foot wing tip to wing tip) and where limited ramp space is available, powered support equipment such as generators, air conditioners, and air compressors may be left in place providing they are shut down and disconnected from the aircraft.

4.1.2.2. When practical, the support equipment parking location should be marked on the ramp.

4.1.2.3. Non explosion-proof powered support equipment required for aircraft fueling and defueling, should be parked the full length of the power cable and kept outside the restricted area. The full length of the cable or airstart duct will be maintained between the fueling point or vents to fighter aircraft. Consideration will be given to the wind direction, ramp slope locations of the aircraft's fuel overflow vents, location of servicing unit or fueling hydrant, and mechanical strain on the power receptacle.

4.1.2.4. The power unit will be positioned upwind from the source of fuel and fuel vapors and uphill when applicable. It will be braked in position and, if necessary because of ramp slope, it will be chocked. Only approved cables will be used with the power unit.

4.1.2.5. Under no circumstances will auxiliary power units be parked under any part of an aircraft.

4.1.3. Aircraft will not be fueled or defueled inside any hangar other than those facilities approved through a System Safety Engineering Analysis conducted according to instructions in TO 00-25-172. Approved facilities to date include TAB VEE shelters, modified TAB VEE, 2nd and 3rd generation aircraft shelters, flow-through revetments, and B-2 maintenance facilities at Whiteman AFB, MO.

4.1.4. Laboratory managers should be concerned with three categories of human factors. These are color vision, analytical aptitude, and fatigue:

4.1.4.1. Without normal color vision, the technician cannot perform all required fuels analytical tests.

4.1.4.2. The need for average analytical aptitude relates to the basic skills as well as an interest in laboratory work. Perhaps the human factor of interest in laboratory testing is as important as technical aptitude, because the analyses are repetitive and the work may be somewhat more confining (e.g., being indoors in one room), than the other fuels functions, such as storage or distribution.

Work in the laboratory involves accurate use of basic mathematics, attention to detail (timing, measuring quantities, use of analytical weight scale), and, for accurate results, cleanliness. It is not unusual for these traits to be inherent in personnel who enjoy the laboratory environment.

4.1.5. The Aircraft Servicing Supervisor will ensure that the requirements of this standard, TO 00-25-172, and specific weapon system TOs are complied with and will maintain and use a current checklist. The Aircraft Servicing Supervisor will know the type and quantity of fuel required. The supervisor will ensure the proper number of people are present, briefed (to include emergency procedures), and positioned properly. AGE equipment will be monitored and a fire extinguisher will be available in the immediate vicinity of the unit when operating.

4.1.6. AGE operators will also act as fire guards during refueling and defueling operations. A maintenance crew member will be responsible for coupling the nozzle to the single-point receptacle and assuring it is locked in place.

4.1.7. The installation fuels operator is responsible for performing the mission in a safe manner and following all safety rules and standards. The operator will continually monitor the equipment for sparks and other ignition sources, unusual noises, and other indications of possible malfunctions. Any time the operator finds the operation to be unsafe, servicing will be immediately stopped. When using hydrant systems, all operating personnel will be briefed on the location and proper use of the system emergency shutoff switch.

4.1.8. Servicing aircraft with the wrong fuel could be catastrophic. Fueling personnel will exercise particular care to ensure that aircraft receive the proper fuels.

4.1.8.1. All transient alert and maintenance control personnel should state both the type of aircraft and the type of fuel desired when requesting dispatch of servicing equipment from the Fuels Control Center (FCC).

4.1.8.2. Refueling drivers should verify, prior to commencing any refueling operation, that the type of aircraft about to be serviced is the same as the type of aircraft specified on the refueling dispatch log.

4.1.8.3. Refueling personnel and the maintenance crew chief will ensure the type of fuel in the servicing unit, as indicated on the unit, is the correct type of fuel required for the aircraft to be fueled, as indicated by the TO, aircraft decals, or other positive means. Similar precautions are of paramount importance when refueling units are refilled from bulk sources.

4.2. Aircraft Fueling and Defueling by Truck. In addition to the general servicing safety precautions and standards, the following unique servicing procedures will be followed when servicing aircraft from fuel trucks.

4.2.1. A minimum distance of 20 feet will be maintained between the aircraft to be serviced and other aircraft, except for fighter, trainer, and light cargo types which may be within 10 feet of each other. Although these are prescribed minimums, it is desirable to keep as much distance as possible between aircraft being fueled and other aircraft. In positioning the tank truck and the aircraft, consideration will be given to spotting them so the fuel vapor will not be carried downwind toward a source of ignition.

4.2.1.1. Proper parking of refueling units is outlined elsewhere in this standard.

4.2.1.2. Fuel servicing vehicles will not be driven or parked under any portion of an aircraft. However, fuel servicing vehicles with an elevated platform may be positioned under the wing of aircraft, provided there is ample clearance and the aircraft is configured for under-the-wing fueling operations. When this type of fuel servicing vehicle is not available, a maintenance platform will be used.

4.2.2. A spotter will be used when backing refueling trucks toward the aircraft. A chock will be prepositioned to act as a stop block to maintain proper aircraft and (or) equipment separation. When the truck is in position, the parking brake will be set and all chocks installed. Refer to Air Force Drawing 42 D 6594.

4.2.3. The operator will closely monitor the control panel and be prepared to shut down in case of a fuel leak or other malfunction.

4.2.4. Emergency shutdown will be accomplished according to applicable TO procedures. In case of a fuel spill, other than minor aircraft venting, the unit will not be evacuated until the area is washed down and declared safe by the installation fire department.

4.2.5. For units not equipped with an operable high level shutoff system, a person will normally be stationed on the top of the refueling truck to observe the fuel level in the tank and to signal the pump operator when the unit is full, in order to avoid an overflow. No maintenance will be performed on the aircraft while it is being defueled.

4.2.6. During multiple unit servicing and multiple aircraft refueling, the refueling unit operators must continuously monitor fuel-flow meters to detect any indication of reverse fuel flow. If reverse flow occurs, operations will be immediately stopped and will not be restarted until the causes are determined and corrected.

4.3. Aircraft Fueling and Defueling From Hydrant Systems:

4.3.1. Fueling and defueling operations employing a hydrant system will be under qualified supervision. A qualified operator will be stationed in the hydrant pump house of type I and II systems during the entire operation for emergency shutdown, if the need arises. This does not apply to type III and IV systems due to built-in emergency deactivation features. The hosecart operator will hold the remote control switch or magnet lanyard throughout the refueling operation. Before fuel delivery is begun, fuel tank caps on the aircraft will be checked to ensure they are secure. The hosecart and "Moosehead" 351 AF valve are of sufficient weight and bulk, especially when there is a hose evacuation malfunction, to require more than one person for handling. To prevent damage, dragging the hose and valve on the ramp is prohibited. For these reasons, other members of the fuel servicing crew will assist the hosecart operator in placing the hose and valve on the hosecart.

4.3.2. In addition to the general servicing safety procedures and standards in paragraph 4.1., the following will be performed.

4.3.2.1. On Type I and II systems, the operator will follow applicable directives to ensure that there is no pressure at the outlet prior to hooking up the "Moosehead" valve.

4.3.2.2. The operator will inspect the remote control cables to ensure they are hermetically sealed and serviceable when used.

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

4.3.2.4. Hosecart operators will ensure hoses are wrapped in a manner to preclude them from rubbing on the tires of the hosecart or dragging on the pavement.

4.3.2.5. Hosecart operators will ensure all personnel involved in the servicing operation are aware of the location of hydrant emergency shut-off switches.

4.4. Fueling New or Recently Repaired Aircraft Tanks or Tanks That Have Been Purged:

4.4.1. If aircraft fuel systems are equipped with nitrogen inerting systems, the tanks may be filled at the normal rate of flow with the nitrogen system activated.

4.4.2. Aircraft not equipped with a nitrogen inerting system must be fueled at the slowest possible flow rate until each fuel cell is full or to the level dictated by the mission. Normal fuel flow rates may be resumed thereafter.

4.5. Fueling From Drums . Refueling from drums must be according to requirements in TO 00-25-172. Essentially the same procedures will be followed for bonding fuel containers and aircraft, as when fueling from tank trucks or hydrants. Particular care will be exercised when fueling from drums, and this should be accomplished only as an emergency measure. Fueling from cans or "topping off" is particularly hazardous and the utmost caution will be observed.

4.6. Ground Servicing Operations:

4.6.1. The inherent hazards of aircraft fuels servicing operations are also present while servicing support equipment vehicles and organizational and (or) support equipment tanks. Commanders, supervisors, and personnel performing these operations must recognize that all fuel servicing operations are hazardous. Ground servicing operations therefore warrant the same degree of attention to safety as those afforded aircraft servicing operations. The refueling units used in ground servicing operations must be subjected to close scrutiny and inspection for safety deficiencies per the locally established maintenance program. Many of the practices designed to contain fuels, and their vapor, and prevent sources of ignition during aircraft operations also apply to ground operations. But, there are several safety features of ground servicing operations that must be noted in this section.

4.6.2. Design and construction of service stations will be according to OSHA Standard 1910.106(g) unless specifically addressed in paragraph 4.6.3.

4.6.3. Support equipment, vehicles, and organizational and (or) support equipment tanks will not be fueled within 50 feet of open flames or spark-producing devices. Personnel will not smoke during fueling operations and will allow sufficient time for fuel vapors to dissipate after the fueling is completed before smoking.

4.6.3.1. Support equipment and vehicles being serviced will be outdoors, with engines turned off and with parking brakes engaged.

4.6.3.2. During fueling, support equipment and vehicle operators will ensure the nozzle of the fuel hose is in constant contact with the filler pipe of the support equipment and (or) vehicle fuel tank, to provide an electrical bond.

4.6.3.3. Similarly, during organizational and (or) support equipment tank servicing operations, the servicing attendant will ensure that the nozzle contacts the filler pipe of the tank.

4.6.3.4. Nozzles used for ground fuel servicing operations will not be equipped with a hold-open latch. Also, nozzles used on the support equipment issue tanks and installation service stations will be the automatic shut-off type.

EXCEPTION. When gravity dispensing tanks are used, a manually operated nozzle will be used.

4.6.3.5. Nozzles used on refueling vehicles or other devices used to service Mogas, diesel, kerosene, or distillate fuels are not required to have static grounding or bonding wires installed, but must maintain contact with the filler pipe at all times during the fueling operation.

Chapter 5

FUELS LABORATORY OPERATIONS

5.1. Use of People in Fuels Handling and Laboratories:

5.1.1. Duty Hours . Normal duty will not exceed 12 hours. Duty times begin when personnel report for duty and end when all fuels operations have been completed or transferred to another individual. For personnel dispatched to duty locations removed from the support installation, duty time does not end until travel to the support installation or specified location for rest is completed.

5.1.2. Rest Period . A normal rest period is that time which will afford an individual the opportunity for a minimum of 8 hours sleep.

5.1.3. Authorized Duties . Only qualified personnel, or personnel under the direct supervision of a lab-qualified individual, will perform laboratory sampling or analyses. Functional managers will certify those personnel authorized to perform specific fuels analyses functions.

5.2. Design Requirements. Installation fuels laboratory design safety criteria is included in Air Force 88-series and AF Joint (AFJ) 32-series regulations and MIL-HDBK-1008 for both existing facilities (as a minimum operating standard) and for new construction. The BCE, installation bioenvironmental engineers, fire chief, and ground safety staff will make an initial inspection to certify the acceptability of the installation fuels laboratory.

5.3. Sampling and Analysis Safety. The installation fuels management offices will establish guidance for general safety, sampling safety, and safety during laboratory analyses.

5.3.1. General:

5.3.1.1. Post safety instructions for handling fuels in the laboratory (attachment 4). Information concerning the hazards of chemicals must be transmitted to employees who are required to work with hazardous chemicals. Per instructions in 29 CFR 1910.1200, labeling of containers, material safety data sheets (MSDS), and training will be provided.

5.3.1.2. Label refrigerators on the outside of the door to indicate “NOT FOR FLAMMABLE STORAGE.” ***CAUTION***: Do not store food or beverage in the refrigerator.

5.3.1.3. The laboratory supervisor will ensure the oven is equipped with a limiting temperature automatic shutoff control. Cooking or eating food or drinking beverages in the fuels laboratory is prohibited.

5.3.1.4. Limit the quantity of test fuel in the laboratory to 10 gallons, including the fuel awaiting analysis.

5.3.1.5. Limit glass containers to the volumes specified in table 5.1. for all fuels.

5.3.1.6. Do not pour fuel into sinks connected to a water drain.

5.3.1.7. Daily inspect waste fuel drums located outside the laboratory and empty them when full**.**

5.3.1.8. Do not use waste fuel to kill vegetation.

5.3.1.9. Post “No smoking” signs at all entrances to the laboratory.

5.3.1.10. Ensure fire extinguishers are readily available in the laboratory. Consult the installation fire chief for proper types.

5.3.1.11. When tests involving fuels or acids are being performed, ensure at least two people, one of whom is a fully qualified lab technician, are in the laboratory.

5.3.1.12. Personnel will not remove from their persons or handle spark-producing materials (such as matches, lighters, keys, etc.), while in the laboratory.

EXCEPTION: Flashpoint laboratory equipment.

5.3.2. Sampling Safety:

5.3.2.1. Bond all sampling equipment when taking samples. Allow time for static charges to equalize before in-line disassembly of sampling equipment.

5.3.2.2. When sampling above-ground storage tanks, use the two-person-policy. Ensure personnel ground themselves prior to climbing the tank ladders by grasping the guardrail with a bare hand. In extremely cold weather, they will grasp a warm metal object (a coin for example) and touch it to the guardrail.

5.3.2.3. Do not sample storage tanks during filling operations. Allow 30 minutes or longer after filling a tank before taking a sample, to allow static electricity charges to dissipate.

5.3.2.4. Use bronze or steel tapes, chains, or cables to lower the sampler into the tank. Ground all metallic components to the tank before the sampling hatch is opened and components are inserted. Continuous contact between the tape and the hatch opening is mandatory while the tape is being lowered into the tank. Do not use nylon or synthetic tape or lines.

5.3.2.5. Do not fill sampling containers beyond the point that will allow adequate space for fuel expansion.

5.3.2.6. Be careful when taking fuel samples from crashed aircraft to prevent ignition of vapors from residual fuel. Contamination is a problem and personnel should ensure that the sample is representative of the uncontaminated fuel in the aircraft fuel tanks.

5.3.2.7. Make sure containers used for sampling conform to the specifications described in table 5.1.

5.3.3. Safety During Laboratory Analyses:

5.3.3.1. Ground or bond all laboratory equipment used in analyzing fuels.

5.3.3.2. Do not use thermometers used in fuel analysis for personal use.

5.3.3.3. Ensure workers are alert to the extra hazards of handling toxic reagents. Local procedures will not deviate from technical order requirements.

5.3.3.4. Keep eye exposure to ultraviolet light to a minimum in the operation and repair of the Aeronautical Engine Laboratory (AEL) water detector.

5.3.3.5. To prevent fires due to static electricity, ground fuel filtration equipment. A safety flask (liquid trap) is required between the vacuum pump and the filtration apparatus to prevent flammable liquid from being drawn into the vacuum pump.

5.3.3.6. Ground drying ovens and waste fuels containers.

5.3.3.7. Petroleum ether used in laboratory analyses is highly flammable. Perform all fuels analyses under operating exhaust hoods.

5.3.3.8. Make sure at least two people, one of whom is a fully qualified laboratory technician, are present in the laboratory when hazardous liquids are being analyzed.

5.3.3.9. Do not leave waste fuel from analyses in the laboratory overnight, unless it is properly stored.

5.3.3.10. Develop emergency procedures and coordinate them with the installation fire chief and safety personnel. These procedures include, but are not limited to, evacuation, equipment shutdown, and notification of the fire department. Emphasize techniques to extinguish clothing fires.

5.3.3.11. Mark all containers in the laboratory, regardless of size, to identify contents. Do not allow workers to suck fuels from containers by mouth.

5.3.3.12. Do not conduct laboratory analyses or allow fuel in the laboratory unless exhaust systems are functioning.

5.3.3.13. Wear approved eye protection equipment when performing or observing fuels analyses. Make sure an approved emergency eye bath is provided.

5.3.3.14. Ensure that all electrical maintenance repair to facilities and equipment meets NFPA 70, *National Electrical Code (NEC)*, requirements.

5.4. Inspection of Fuels Laboratory . Fuels laboratory inspections are placed into one of two general categories: external support inspections (e.g., installation fire chief, bioenvironmental engineer, and safety representative) or daily, weekly, or monthly internal inspections by laboratory supervisors. In each case, the inspection is conducted to identify and eliminate hazards before they cause a mishap. Personnel should be instructed to notify their supervisors of potential hazards and encouraged to submit hazard reports. Hazards will be categorized according to potential severity and probability of occurrence (see AFI 91-301). Immediate action will be taken to eliminate those hazards in Categories IA, IB, IIA, and IIB.

5.4.1. External Support Inspections. For the basic safety of the laboratory, it is important that periodic (at least annual) inspections by other installation agencies be accomplished. As a minimum, these inspections should be accomplished by the installation fire chief, bioenvironmental engineer, and ground safety officer. The bioenvironmental engineer will conduct an employee exposure determination according to requirements in AFOSH Standard 48-22, *Occupational Exposure to Hazardous Chemicals in Laboratories,* whenever there is reason to believe that exposure may be hazardous. Reports of the results of these inspections will be maintained by the functional manager.

5.4.2. Internal Inspection of Fuels Laboratory . Fuels laboratory internal safety inspections are the responsibility of all assigned personnel. Potential safety and health hazards must be identified and hazard abatement plans established as outlined in AFI 91-301. Items requiring special attention during daily, weekly, or monthly internal inspections are as follows:

5.4.2.1. Inspect electrical connections of equipment for loose or defective connections and frayed insulation.

5.4.2.2. Visually inspect ground wires for frays or loose connections. Check electrical continuity monthly with a resistance (ohm) meter.

5.4.2.3. Inspect the electrical grounding of the fuels laboratory building monthly and electrical resistance annually. Electrode resistance to ground should not exceed 25 ohms under dry conditions.

5.4.2.4. Ensure laboratory personnel use protective clothing and equipment when handling acids.

5.4.2.5. Make sure all acid solutions are stored in a double container.

5.4.2.6. Ensure labels on containers accurately reflect contents.

5.4.2.7. Make sure waste fuel containers are emptied daily.

5.4.2.8. Assure only authorized personnel are in the laboratory when fuels are being tested.

5.5. Housekeeping . Good housekeeping is essential while performing tasks in the fuels laboratory and is the responsibility of all personnel.

5.5.1. Provide plainly marked metal containers with self-closing lids in fuels laboratories for disposal of combustible waste such as rags, paper towels, and other flammable solid materials. Paint these containers yellow with red letters designating "COMBUSTIBLE SOLID WASTE."

5.5.2. Fuel spills in the laboratory can cause fires and create slipping hazards. When spills occur, clean them up immediately.

5.5.3. Use only noncombustible absorbent materials to dry up spills of flammable materials. Do not use sawdust or wood shavings as an absorbent.

5.5.4. Do not clean fuels laboratory floors with flammable liquids. Use nonskid waxes for floor tile protection.

5.5.5. Unless manufacturer's instructions require otherwise, unplug all lab equipment at the end of the normal work day.

5.5.6. Keep outside areas around fuels laboratories free of weeds, trash, and other combustible materials.

5.5.7. Ensure aisles in fuels laboratories are clear at all times to permit unobstructed movement of personnel in case of fire.

5.5.8. Limit waste fuel containers within the laboratory to 5 gallons each. Empty the containers when full and at the end of the normal work day. Paint containers red with a 2-inch yellow band around the center of the container. Stencil the grade of fuel in 1-inch letters inside the yellow band on the front side of the containers. Never pour acids into fuel containers.

5.5.9. Position a 55-gallon drum, or an equivalent container, outside the laboratory at least 50 feet from the building. Use this drum to store fuel deposited from 5-gallon containers in the lab. Paint the drum red with a 4-inch yellow band around the center of the drum. Stencil the grade of fuel in 2-inch letters inside the yellow band on the front side of the drum. Ground all waste containers and drums.

Table 5.1. Maximum Allowable Size of Containers and Metal Portable Tanks.

	Flammable Liquids		Combustible Liquids		
Container Type	**Class IA**	**Class IB**	**Class IC**	**Class H**	**Class M**
Glass	1 pt	1 qt	1 gal	1 gal	5 gal
Metal (other thanDepartment of Transportation (DOT) drums) or approved plastic	1 gal	5 gal	5 gal	5 gal	5 gal
Safety Cans	2 gal	5 gal	5 gal	5 gal	5 gal
Metal Drum (DOT Spec.)	60 gal	60 gal	60 gal	60 gal	60 gal
Approved Metal Portable Tanks	660 gal	660 gal	660 gal	660 gal	660 gal
Polyethylene DOT Spec 34, or as authorized by DOT Exemption	1 gal	5 gal	5 gal	60 gal	60 gal

FRANCIS C. GIDEON, JR., Maj Gen, USAF
Chief of Safety

Attachment 1

GLOSSARY OF REFERENCES, ABBREVIATIONS, ACRONYMS, AND TERMS

References

Air Force Instruction (AFI) 23-201, *Fuels Management.*

AFI 23-204, *Organization Fuel Tanks.*

AFI 32-1024, *Standard Facility Requirements.*

AFI 91-301, *Air Force Occupational and Environmental Safety, Fire Prevention, and Health (AFOSH) Program.*

AFI 131-209, *The Installation and Resources Protection Program.*

Air Force Manual (AFMAN) 24-306, *Manual for the Wheeled Vehicle Driver.*

AFMAN 85-16, *Maintenance* of *Petroleum Systems.*

Air Force Occupational Safety and Health (AFOSH) Standard 48-1, *Respiratory Protection Program.*

AFOSH Standard 48-2, *Industrial Ventilation* (formerly designated as AFOSH Standard 161-2).

AFOSH Standard 48-8, *Controlling Exposures to Hazardous Material.*

AFOSH Standard 48-21, *Hazard Communication.*

AFOSH Standard 48-22, *Occupational Exposure to Hazardous Chemicals in Laboratories.*

AFOSH Standard 91-20, *Vehicle Maintenance Shops* (formerly designated as AFOSH Standard 127-20).

AFOSH Standard 91-25, *Confined Spaces.*

AFOSH Standard 91-31, *Personal Protective Equipment* (formerly designated as AFOSH Standard 127-31).

AFOSH Standard 91-32, *Emergency Shower and Eyewash Units* (formerly designated as AFOSH Standard 127-32).

AFOSH Standard 91-44, *Safety Color Coding, Labeling, and Marking for Piping Systems* (formerly designated as AFOSH Standard 127-44).

AFOSH Standard 91-56, *Fire Protection and Prevention* (formerly designated as AFOSH Standard 127-56).

AFOSH Standard 91-100, *Aircraft Flight Line - Ground Operations and Activities* (formerly designated as AFOSH Standard 127-100).

Military Handbook (MIL-HDBK) 1008, *Fire Protection for Facilities Engineering, Design, and Construction.*

Military Standard (MIL-STD) 161F, *Identification Methods for Bulk Petroleum Products Including Hydrocarbon and Missile Fuels.*

National Fire Protection Association (NFPA) Standard 11, *Standard for Low Expansion Foam and Combined Agent Systems.*

NFPA 30, Fl*ammable and Combustible Liquids Code.*

NFPA 70, *National Electrical Code (NEC).*

Occupational Safety and Health Administration (OSHA) Standard 29 Code of Federal Regulations (CFR) 1910.104, *Oxygen.*

OSHA Standard 29 CFR 1910.106, *Flammable and Combustible Liquids.*

OSHA Standard 29 CFR 1910.1025, *Lead.*

OSHA Standard 29 CFR 1910.1028, *Occupational Exposure to Benzene.*

OSHA Standard 29 CFR 1910.1200, *Hazard Communication.*

Technical Order (TO) 00-20B-5, *USAF Motor Vehicle and Vehicular Equipment Inspection.*

TO 00-25-172, *Ground Servicing of Aircraft and Static Grounding/Bonding.*

TO 1-1-3, *Inspection and Repair of Aircraft Integral Tanks and Fuel Cells.*

TO 37-1-1, *Operation, Inspection, and Maintenance of Permanently Installed Fuel Storage and Dispensing Systems.*

TO 42B1-l, *Quality Control Fuels and Lubricants.*

TO 42B1-1-14, *Fuels for USAF Aircraft.*

Abbreviations and Acronyms

AEL—Aeronautical Engine Laboratory

AFI—Air Force Instruction

AFJ—Air Force Joint

AFMAN—Air Force Manual (New Designation)

AFOSH—Air Force Occupational Safety and Health

AFSC—Air Force Safety Center

BCE—Base Civil Engineer

BX—Base Exchange

C—Centigrade

CFR—Code of Federal Regulations

DOD—Department of Defense

DOT—Department of Transportation

DRU—Direct Reporting Unit

F—Fahrenheit

FCC—Fuels Control Center

FOA—Field Operating Agency

FSC—Federal Stock Class

FSSZ—Fuel Servicing Safety Zone

HQ—Headquarters

LOX—Liquid Oxygen

MAJCOM—Major Command

MIL-HDBK—Military Handbook

MIL-STD—Military Standard

MSDS—Material Safety Data Sheets

NATO—North Atlantic Treaty Organization

NEC—National Electrical Code

NFPA—National Fire Protection Association

nm—Nautical Mile

OSHA—Occupational Safety and Health Administration

PDO—Publishing Distribution Office

POL—Petroleum/Oil/Lubricant

TO—Technical Order

WWW—World-Wide Web

Terms

Analysis—The end result of laboratory tests to determine product qualities and constituents such as, but not limited to, sediment, water, fuel system icing inhibitor, or heavy hydrocarbons. Specialized laboratory equipment is required, including analytical balance, oven, and pH meter.

Additives—Chemicals that are added in small proportions to a parent substance to create, enhance, or suppress a certain property or properties.

Aromatic Hydrocarbons—A family of compounds related to benzene, characterized by the presence of an aroma.

Benzene—A colorless, flammable, and volatile liquid obtained from petroleum by refining distillation. Benzene is a carcinogenic substance (AFOSH Standard 48-8).

Chemical—While all matter is chemical in nature, those in the laboratory are marked (labeled) and maintained for use during laboratory analyses.

Conductivity—The ability of a material to conduct electricity.

Conductivity Additive—A chemical additive that imparts conductivity to the fuel to aid in dissipating the electrostatic charge.

Flashpoint—The minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid.

Fuel—Any substance which will vaporize and burn in the presence of oxygen. Liquid fuels are classed as flammable or combustible depending upon their flashpoints.

Grounding and Bonding—The process of connecting one or more objects with electrical conductors to ground electrodes (or earth). Bonding is done to equalize electrostatic potential between two or more objects.

Hydrocarbon Fuels—Consisting entirely of hydrocarbon compounds, certain additives being permitted.

Inspection—The process of visually checking a sample or performing an odor test as for liquid oxygen. The inspection process is mainly confined to products received during day-to-day operations.

Installation Fuels Laboratory—The laboratory managed by the Installation Fuels Management Flight Chief where samples of aviation fuel, ground fuel, and thrust augmentation fluids are analyzed for quality.

Lower Explosive Limit—The minimum concentration of combustible gas or vapor in air, below which propagation of flame does not occur on contact with a source of ignition.

Lower Flammable Limit—See Lower Explosive Limit.

May— Indicates an acceptable or satisfactory method of accomplishment.

Shall—Indicates a mandatory requirement.

Should—Indicates a preferred method of accomplishment.

Specific Gravity—The ratio of the density of the substance in question to the density of water at a specified temperature. The specific gravity of a flammable liquid is important in fire fighting where water or other liquids are present. Many flammable liquids with specific gravities less than one (lighter than water) are also insoluble in water. In the event of fire with such liquids present, water may be ineffective as an extinguishing agent.

Storage Cabinet—A cabinet for the storage of flammable and combustible liquids that is constructed according to the requirements for storage cabinets of flammable and combustible liquids (29 CFR 1910.106).

Tetraethyl Lead—A toxic lead compound which, when added in small proportions to gasoline, increases its octane rating.

Thermal Stability—Capable of being subjected to a moderate degree of heat without loss of characteristic properties.

Unattended Laboratory Operations—No person present who is technically knowledgeable regarding the operation and emergency shutdown procedures.

Upper Explosive Limit—The maximum proportion of vapor or gas in air, above which propagation of flame does not occur on contact with a source of ignition.

Upper Flammable Limit— See Upper Explosive Limit.

Volatility—Refers to the ease with which a specific liquid will change into the vapor state. High volatility fuels vaporize (or evaporate) easily. Volatility is temperature dependent; the higher the temperature, the more rapid the vaporization of the liquid.

Waste Fuel—Products which are no longer suited for their intended use and cannot be used as another fuel because of contamination or dilution.

Waste Safety Can—An approved container of not more than 5 gallons capacity, having a spring closing lid and spout cover and designed so it will safely relieve internal pressure when subjected to fire exposure.

Will—Is also used to indicate a mandatory requirement and in addition is used to express a declaration of intent, probability, or determination.

Attachment 2

AIRCRAFT FUEL CLASSIFICATIONS

Complete description of aircraft fuel classifications, characteristics, and use are contained in TO 42B1-1-14*, Fuels for USAF Aircraft.* The information in this attachment has been extracted from this TO and summarized for convenience.

A2.1. General. Aircraft fuels are classified under four general types: Wide-cut type (JP-4 and Jet B), kerosene type (JP-8, Jet A-1, and Jet A), high flashpoint kerosene (JP-5), and aviation gasoline. All four types are utilized in turbojet and turboprop engines with certain restrictions. Only aviation gasoline is suitable for use in reciprocating engines.

A2.1.1. Wide-Cut Type (JP-4 and Jet B). Wide-cut fuels are mixtures of gasoline and kerosene distillate fractions with an approximate boiling range of 35 degrees centigrade (C) to 315 degrees C (95 degrees F to 600 degrees F).

A2.1.2. Kerosene Type *(JP-8, Jet A-1, and Jet A).* Kerosene type fuels are petroleum distillates with an approximate boiling range of 165 degrees C to 290 degrees C (330 degrees F to 550 degrees F).

A2.1.3. High-Flashpoint Kerosene (JP-5). High-flashpoint kerosene fuel has essentially the same characteristics as the kerosene fuels, but with a minimum flashpoint of 60 degrees C (140 degrees F).

A2.1.4. Aviation Gasoline. Gasoline is a petroleum distillate with an approximate boiling range of 35 degrees C to 165 degrees C (95 degrees F to 330 degrees F). Gasoline-type fuels are not used to any large extent in aircraft turbojet and turboprop engines because of poor lubricating properties as compared to kerosene-type fuels and because of lead additives which have an adverse effect on aircraft turbine engines.

A2.2. North Atlantic Treaty Organization (NATO) Turbine Engine Fuels. In overseas areas, turbine engine fuels may be identified by a NATO symbol. Consult TO 42B1-1-14 for guidance.

Attachment 3

SAFETY GUIDE FOR HYDROCARBON FUELS

A3.1. Hazards:

A3.1.1. Contact with skin can cause scaling, fissuring of skin, and blistering.

A3.1.2. Contact with eyes causes irritation (liquid fuel or vapors).

A3.1.3. Swallowing fuels may cause poisoning.

A3.1.4. Gasping while swallowing or aspiration from vomiting can introduce fluid into the lungs and may cause chemically induced pneumonia.

A3.1.5. Inhaling vapors may cause dizziness.

DANGER: In confined spaces of pits, fuel vapors may overcome a worker and cause death due to asphyxiation.

A3.1.6. Spills may cause dangerous fire hazards:

A3.1.6.1. Fuel vapors can burn or explode when exposed to an ignition source.

A3.1.6.2. If hydrocarbon fuels and rocket oxidizers are spilled and mixed, the mixture can be exploded by chemical reaction, heat, or spark. They may even explode spontaneously.

A3.1.7. Gasoline hydrocarbon fuels with tetraethyl lead are highly toxic to the central nervous system. Tetraethyl lead can be:

A3.1.7.1. Absorbed through the skin;

A3.1.7.2. Inhaled; or

A3.1.7.3. Ingested:

- By direct contact with the petroleum product; or
- Indirectly through contact with petroleum sludges, tank scale, and tank rust.

A3.1.8. Hydrocarbon fuel vapors can displace oxygen in enclosed spaces and pits and cause asphyxiation, unconsciousness, and death.

A3.2. First Aid:

A3.2.1. Remove contaminated clothing and wash affected skin areas with soap and water.

A3.2.2. If fuel is splashed into the eyes, immediately flush the eyes with large amounts of water continuously for at least 15 minutes. Get medical attention immediately.

A3.2.3. If swallowed, do not induce vomiting. Get medical attention immediately.

A3.3. Safety Precautions:

A3.3.1. Know the characteristics of the hydrocarbon fuels being handled.

A3.3.2. Immediately repair any malfunction of a refueling vehicle's exhaust system.

A3.3.3. Use only approved electrical plugs, clips, and conductors during servicing operations.

A3.3.4. Cease fuel operations (except pipeline receipts and military or BX service stations) when advised by the weather officer that an electrical storm is within a 5 nm radius of the installation. Do not resume operations until advised to do so by the FCC.

A3.3.5. Know which operations require the presence of two people.

A3.3.6. Do not wear shoes with exposed nails or metal plates.

A3.3.7. Do not remove outer garments around fuel storage or servicing operations since this creates static electricity.

A3.3.8. Remove rings and other items of jewelry while engaged in fuel operations (whenever possible or when required by supervision).

A3.3.9. Wear an approved self-contained breathing apparatus when entering confined spaces where there are high fuel vapor concentrations. Consult local bioenvironmental engineering personnel for specific requirements.

A3.3.10. Ensure that eyewashes and personal protective and fire extinguishing equipment are available and operational prior to operations involving hydrocarbon fuels.

A3.3.11. Ensure that all equipment used in hydrocarbon fuel operations is properly grounded.

A3.3.12. Immediately clean up Class I fuel spills. For Class II and III fuel spills, immediately notify the fire protection organization (vapors from hydrocarbon fuels can form dangerous explosive mixtures with air).

A3.3.13. Wash hands thoroughly with soap and water after working with fuels.

A3.3.14. Remove clothing that has been splashed with hydrocarbon fuels as soon as possible. Air dry and launder before using again. Prior to laundering, air out the contaminated clothing. Do not place fuel-soaked clothing in lockers or other confined spaces. Air clothing until thoroughly dry.

Attachment 4

SAFETY INSTRUCTIONS FOR FUELS LABORATORIES

(To be posted in all base fuels laboratories)

A4.1. Hazards:

A4.1.1. Contact with skin or eyes causes irritation.

A4.1.2. Swallowing fuels causes poisoning.

A4.1.3. Inhaling vapors may cause drowsiness, intoxication, or asphyxiation.

A4.1.4. Spills cause dangerous fire hazards.

A4.2. First Aid:

A4.2.1. Remove fuel contaminated clothing and wash affected skin areas with soap and water.

A4.2.2. If fuels are swallowed, DO NOT induce vomiting. Get medical attention immediately.

A4.2.3. If fuel is splashed in eyes, flush with water. Get medical attention.

A4.3. Safety Precautions:

A4.3.1. Know the general characteristics of fuels.

A4.3.2. Verify that personal protective and fire protection equipment are available and in working order prior to operations involving fuel.

A4.3.3. All electrical equipment used in fuel operations must be properly grounded.

A4.3.4. Avoid spills. Vapors from fuel can form explosive mixtures with air.

A4.3.5. Always wash hands thoroughly with soap and water after working with fuels.

A4.3.6. Clothing that has been splashed with fuel must be removed, dried out, and laundered before being worn again. Take care in removing fuel-soaked clothes to prevent electrostatic ignition. Air clothing until thoroughly dry. DO NOT place fuel-soaked clothing in lockers or other enclosed spaces.

Attachment 5

CHECKLIST

This is not an all-inclusive checklist, it simply highlights some critical items in this standard. Other requirements exist that are not included in the checklist. Where appropriate, MAJCOMs, DRUs, FOAs, local safety personnel, and supervisors will add to this checklist to include command or individual shop-unique requirements or situations.

A5.1. Have possible sources of ignition been identified and prohibited from areas where there is a potential for the presence of flammable vapors? (Reference paragraph 2.1.1)

A5.2. Have sources of static electricity and areas where electrostatic charge buildup is likely been identified and appropriate safety precautions taken? (Reference paragraph 2.2)

A5.3. Are static grounds with resistances of more than 10,000 ohms removed or repaired? (Reference paragraph 2.2.5.1)

A5.4. Have all damaged static grounds been repaired and retested for resistance values? (Reference paragraph 2.2.5.2)

A5.5. Have all personnel required to work in environments where petroleum products are present been instructed in the hazards of static electricity? (Reference paragraph 2.4.2)

A5.6. Is the two person policy employed, where appropriate? (Reference paragraph 2.4.4)

A5.7. Are all personnel involved in fuel handling operations trained in minimizing the possibility of fuel spills and proper response procedures if a spill does occur? (Reference paragraph 2.4.5)

A5.8. Are proper procedures being utilized for entering petroleum storage tanks? (Reference paragraph 2.5)

A5.9. Are the minimum safety features present in locations where petroleum products are handled or stored? (Reference paragraph 2.6)

A5.10. Are emergency shower and eyewash units in place? (Reference paragraph 2.6.1)

A5.11. Are the procedures for response to adverse weather conditions during fuel servicing operations established? (Reference paragraph 2.7)

A5.12. Do fuel servicing and maintenance activities cease when electrical storms are within a 5 nm radius of the installation? (Reference paragraph 2.7.2)

A5.13. Are controls exercised over the wearing of jewelry during fueling operations? (Reference paragraph 2.9)

A5.14. Do petroleum facilities conform to applicable Air Force specifications? (Reference paragraph 3.1)

A5.15. Is adequate ventilation being provided to below-grade pumphouses and deep pits? (Reference paragraph 3.1.2.1)

A5.16. Are fuel transport vehicles electrically bonded to the offloading header during fuel handling operations? (Reference paragraph 3.2.1)

A5.17. Are proper procedures for fuel transfer operations, including gauging and temperature measurement, being utilized? (Reference paragraph 3.2.4)

A5.18. Are danger signs being used correctly? (Reference paragraph 3.2.5)

A5.19. Is adequate fire protection being provided for fuel handling operations? (Reference paragraph 3.2.6)

A5.20. Do local fuel movement procedures include emergency shutdown procedures? (Reference paragraph 3.2.10)

A5.21. Are procedures established to ensure safe fuel truck-fillstand operations? (Reference paragraph 3.3)

A5.22. Are electrical bonding procedures established and followed for fuel truck-fillstand operations? (Reference paragraph 3.3.3)

A5.23. Have procedures been established to ensure the safety of railroad tank car operations? (Reference paragraph 3.4)

A5.24. Have all sources of ignition been eliminated during aircraft servicing operations? (Reference paragraph 4.1)

A5.25. Has an FSSZ been established for fuel servicing operations? (Reference paragraph 4.1.1)

A5.26. Does the Aircraft Servicing Supervisor use a checklist to ensure the requirements of this standard, TO 00-25-172, and weapon system TOs are complied with? (Reference paragraph 4.1.5)

A5.27. When using hydrant systems, have all operating personnel been briefed on the location and proper use of hydrant system emergency shutoff switch? (Reference paragraph 4.1.7)

A5.28. Do refueling drivers verify the type of aircraft about to be serviced is the same type aircraft specified on the refueling dispatch log? (Reference paragraph 4.1.8.2)

A5.29. Are spotters used when backing refueling trucks toward the aircraft? (Reference paragraph 4.2.2)

A5.30. Are the precautions specified in paragraph 4.3.2. followed for hydrant system fueling operations?

A5.31. Have the hazards associated with ground servicing operations been recognized and addressed? (Reference paragraph 4.6.1)

A5.32. Have all concerns for safe fuels laboratory operations been addressed? (Reference paragraph 5.1)

A5.33. Have safety instructions for handling fuels in the laboratory been posted? (Reference paragraph 5.3.1.1)

A5.34. Are fire extinguishers readily available in fuels laboratories? (Reference paragraph 5.3.1.10)

A5.35. Is the handling of spark-producing materials prohibited in the laboratory? (Reference paragraph 5.3.1.12)

A5.36. Have the unique hazards involved with fuel sampling been addressed? (Reference paragraph 5.3.2)

A5.37. Have procedures been established to minimize the possibility of electrostatic discharge during sampling operations? (Reference paragraph 5.3.2)

A5.38. Are all containers in the laboratory marked to identify contents? (Reference paragraph 5.3.3.11)

A5.39. Have inspection schedules been established for fuel laboratories? (Reference paragraph 5.4)