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ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: FIRE PREVENTION DURING AIRCRAFT FUELING OPERATIONS

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1. PURPOSE. This advisory circular provides information on fire preventative measures which aircraft servicing personnel should observe during fueling operations. Failure to observe these preventative measures may result in a serious fire loss.

2. REFERENCES.

   a. Copies of Advisory Circular 150/5210-5, Painting, Marking, and Lighting of Vehicles Used on an Airport, and additional copies of this circular may be obtained from the Department of Transportation, Distribution Unit, TAD 484.3, Washington, D.C. 20590.

   b. Copies of the following publications may be purchased for a nominal price from the National Fire Protection Association (NFPA), 60 Batterymarch Street, Boston, Massachusetts 02110:

      (1) NFPA Publication No. 10, Portable Fire Extinguishers, Installation.

      (2) NFPA Publication No. 10A, Portable Fire Extinguishers, Maintenance and Use.

      (3) NFPA Publication No. 30, Flammable and Combustible Liquid Code.

      (4) NFPA Publication No. 385, Tank Vehicles for Flammable and Combustible Liquids.

      (5) NFPA Publication No. 407, Aircraft Fuel Servicing.

      (6) NFPA Publication No. 410C, Aircraft Fuel System Maintenance.

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(7) NFPA Publication No. 411, Aircraft Ramp Hazards.

(8) NFPA Publication No. 415, Aircraft Fueling Ramp Drainage.

c. Copies of the following publications may be purchased for a nominal price from the American Petroleum Institute (API), 1271 Avenue of Americas, New York, New York 10020:

(1) API Safe Practices in Bulk Plant Operations.

(2) API Bulletin 1501, The Filtration of Water Removal From Aviation Fuels.

(3) API Bulletin 1502, The Installation of Fixed Fuel Handling Equipment at Airports.

(4) API Bulletin 1503, The Storage and Handling of Jet Fuels at Airports.

(5) API Bulletin 1505, Airport Fueling Systems Planning Criteria.

(6) API Bulletin 1523, Fueling Turbine-Powered Aircraft.

(7) API Bulletin 1542, Aviation Fuels Identification and Airport Equipment Marking and Color Coding.

(8) API Bulletin 1543, Aviation Fueler Truck Bottom Loading Systems.

d. Aircraft Fueling Up To Date may be purchased for a nominal price from the Flight Safety Foundation, 468 Park Avenue South, New York, New York 10016.

e. Copies of the following publications may be purchased for a nominal price from the National Safety Council, 425 North Michigan Avenue, Chicago, Illinois 60611:

(1) Safety Graph No. 31 on Aircraft Fuel Servicing.

(2) Industrial Data Sheet D-A-4, Aircraft Ground Fuel Servicing Hazards.

3. DEFINITIONS.

a. Fueling, as used in this circular, includes all fuel transfer activities, such as fueling, defueling, and draining of aircraft fuel tanks.

b. Volatility is the tendency of a liquid fuel to evaporate or change to a vapor.

c. Flashpoint is the temperature at which a petroleum fuel first gives off enough flammable vapors to ignite.

d. Flammability limit is the range of fuel-to-air mixture which will support combustion.

4. GENERAL.

a. It is not the intent of this circular to replace company procedures which are tailored to meet requirements imposed by special equipment or local regulations. It is devoted chiefly to highlighting procedures and practices which, if not strictly complied with or corrected, may contribute to unsafe conditions and increase the fire probability factor.

b. The three factors of fuel, heat or ignition, and oxygen, commonly referred to as the fire triangle, will be examined to determine methods of controlling or eliminating them to prevent fire.

c. The publications listed in Paragraph 2 of this circular, as well as airline, aircraft manufacturing, and fuel servicing company manuals, deal in detail with the fire hazards associated with aircraft fueling operations. The safety recommendations contained therein should be considered.

5. SOME FUEL FACTS.

a. Some facts concerning aircraft fuel are repeated herein to emphasize the effect on fire propagation. Before aircraft fuel can be ignited, it must be:

(1) converted to a vapor,

(2) mixed in the correct proportion with air to provide the oxygen necessary for combustion,

(3) in the presence of an ignition source.

b. Without any one of the three factors making up the fire triangle, and in the proper relationship, fire is impossible whether it is in a reciprocating engine cylinder, turbine engine combustion chamber or afterburner, or an open spill on the ground.

c. The volatility, flashpoint, and flammability limit of fuel affect its ignition and burning characteristics. Volatility is affected by changes in temperature and atomization or misting of the fuel.

d. Turbulence or agitation of the fuel, such as may occur during tank filling operations, increases the probability for generating static electricity which may provide an ignition source.

e. All petroleum fuels have flammability limits. Fuel-to-air mixtures above or below this flammability range are either too rich or too lean to support combustion.

6. SOME IGNITION FACTS AND METHODS OF CONTROL. Some sources, which may ignite flammable liquid vapors, and methods for eliminating or controlling these ignition sources are as follows:

a. Smoking. Prohibit smoking in areas where fueling operations are, or are likely to be, conducted. Conspicuously display "No Smoking" signs to warn smokers of the hazardous areas, and rigidly enforce this rule.

b. Open Flames. Do not permit, in close proximity to where fueling operations are being conducted, open flames from matches, cigarette lighters, flare pots, or similar open-flame lights; welding, cutting, and blow torches; exposed flame heaters (including portable gasoline or kerosene heaters), and exhaust from internal combustion engines.

c. Sparks. Sparks are frequently created from electrical equipment being turned on or off and when being disconnected. These sparks can cause ignition if flammable vapors are present. Prohibit the following during fueling operations:

(1) Installation or removal of batteries.

(2) Connection or disconnection of battery chargers or ground power units.

(3) Connection or operation of ground power units, except at locations as remote from the fueling point as possible and never under the aircraft wing.

(4) The use of electrical tools, such as drills, buffers, etc., in or near the aircraft.

(5) Operation, except in an emergency, of aircraft electrical switches which control units in the wing or tank areas not necessary to fueling operations.

(6) The use of photo flashbulbs within 10 feet of fueling equipment.

(7) Unapproved flashlights or electrical hand lamps in hazardous locations near the fueling point.

(8) The use of high-frequency ground or airborne radar equipment, unless a separation of 50 and 300 feet, respectively, between energized airborne and ground radar equipment is maintained.

(9) Tossing or dropping of tools and equipment or dragging metal ladders on the ramp area when fueling operations are in progress.

(10) The use of metal-wheeled equipment in the vicinity of the aircraft.

d. Power-Operated Ramp Vehicle Ignition and Exhaust Systems. Improperly maintained ignition and exhaust systems on these vehicles may cause short circuiting and arcing across electrical terminals and backfire in the exhaust manifolds. It is imperative that fueling crews report evidence of malfunction in these systems for immediate repair.

e. Exhaust Gases. Conducting fueling operations upwind from operating turbine or reciprocating engines is a preferred practice.

f. Hot Metal Parts. Hot metal parts, such as brake drums, may ignite dripping fuel or fuel mist. Take precautions to prevent fuel or fuel mist from coming into contact with hot brake assemblies.

g. Stray Electrical Currents and Static Electricity. These are sources of ignition if present in a flammable fuel-to-air mixture. Subparagraphs (1) through (3) below list sources of stray electrical currents, and subparagraphs (4) through (9) list sources of static electricity.

(1) Improperly made connections between ground power units and the aircraft.

(2) Electrical shorts from electrical power sources to the fuel system.

(3) Cathode protection systems frequently provided to reduce corrosion of underground lines to the tank bottoms.

(4) Fuel flow in servicing hose. The greater linear fuel flows, utilized to service jet aircraft, increase the static electric charge in the fuel servicing hose.

(5) Free falling fuel through air in fill spout.

(6) Turbulence in the fuel.

(7) Flow of rain, snow, or dust across the aircraft surfaces.

(8) Rubber-tired vehicles.

(9) Electrically charged atmospheres. During severe lightning and electrical storms, fueling operations should be discontinued. Prevention of the presence of a flammable fuel-to-air mixture in areas adjacent to open fuel intakes is impossible. Do not permit static electricity, which accumulates on the aircraft or in the fuel service equipment, to discharge as a spark but drain it to the ground or to the ground rods. External sparking due to static or stray electricity can be reduced by providing an easy path for the electricity to follow to the ground through a conductive lead. Grounding of the fuel service vehicle and bonding of the service vehicle and the hose nozzle to the aircraft, prior to start of fueling, should safely dissipate whatever static or stray electricity has been built up in the aircraft or service vehicle. Bonding, by equalizing or draining the electric potentials, prevents sparks. Strictly comply with the bonding and ground requirement promulgated in the reference material.

7. FUEL SPILLS - PREVENTION AND CONTROL.

a. Fuel spills are often the result of improper or careless operation of fueling equipment and lack of preventative maintenance of the mechanical fueling equipment. Therefore, it is imperative that

operating personnel comply with the company procedures established to govern fueling operations and report any leakage of the equipment used during the fueling operations to supervisory personnel.

b. Self-discipline on the part of every man on the fueling crew is required to prevent fuel spilling. Operating personnel are required to:

(1) Never leave any fuel nozzle unattended.

(2) Never tie or wedge the nozzle trigger in an open position.

(3) Devote full attention to the fueling operation.

(4) Frequently check the amount of fuel in the tank to prevent overfilling.

(5) Understand the operations of the automatic and deadman switches or shutoff valves in the aircraft fuel system; precheck or verify their operating conditions; and constantly monitor their operations when using under-wing filling procedures.

(6) Stop the flow of fuel immediately upon discovering leakage or spillage from the fuel servicing equipment.

(7) Always insure pump selector valve is in "OFF" position prior to changing nozzle from over-wing to under-wing or vice versa using the quick-disconnect coupling.

c. Spill fires are usually classified with respect to the area or pool size. The three sizes of spills usually considered are:

(1) Less than 18 inches in dimension, in any direction.

(2) Not over 50 square feet, not over 10 feet in dimension in any direction, and not of a continuing nature.

(3) Over 50 square feet, over 10 feet in dimension in any direction, and of a continuing nature.

The action to be taken in case of spills in each of these sizes is contained in Part II of NFPA Publication No. 407.

8. TRAINING. Careful instructions in operating procedures are required for all personnel involved in fueling to insure safe performance of their duties. Perform fuel servicing only when:

   a. Personnel competent to perform this service are available.

   b. Adequate manpower is constantly available to control the flow of fuel in case of an emergency.

9. SAFETY INSPECTION. Initiate a continuing program under the direction of a fueling supervisor or safety engineer for monitoring fueling operations to insure compliance with safety regulations. Direct particular attention in this program with respect to:

   a. Positioning of fuel servicing equipment during fueling operations so that clear exit paths are maintained; equipment can be driven away, without the need of reverse (in case of an emergency); and personnel exits are not obstructed.

   b. Fueling operations being conducted with sufficient manning, and to insure that fuel servicing vehicles are not parked unattended, except when parked in designated parking areas.

   c. Operation of the equipment by qualified personnel only.

   d. Suitable precautions being taken to prevent movement of the aircraft and fuel servicing equipment by setting the vehicle brakes, using wheel chocks, or both.

   e. Fueling at sites where the fueling equipment, or fuel tank vents, are in close proximity to any building other than those parts of the building(s) constructed for direct loading or unloading of aircraft.

   f. Proper bonding and grounding of fuel servicing equipment and aircraft.

   g. Smoking or use of open flames within the fueling zone usually considered to be 50 feet radially from any filling or venting points.

   h. Suitability, availability, and maintenance of fire extinguishers located in the vicinity of the fueling operations.

i. Training of fuel service personnel in the proper use of available fire extinguishers and how to summon the aircraft fire and rescue service.

j. Precautions to be taken when fueling is performed with passengers still on board the aircraft, such as:

(1) Availability of passenger exits in the form of a stand, loading bridge, or integral stairway.

(2) Two qualified cabin attendants (stewardesses should be in attendance during the fueling operation).

(3) Illuminate "No Smoking" signs and "Exit" lights.

k. Parking and driving of catering and service trucks in close proximity or under aircraft wings during fueling operations. Supervisory personnel should thoroughly instruct drivers of these vehicles as to the inherent hazards associated with fueling operations.

l. Operation of auxiliary power units (APU's) installed aboard aircraft. These units may be operated during fueling operations provided, in the design and installation, adequate attention has been given to fuel vapor and ignition hazards which may be involved.

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