



**DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION**

SUBJECT: AIRCRAFT GROUND HANDLING AND SERVICING

**ADVISORY
CIRCULAR**

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1. PURPOSE. This advisory circular contains information and guidance for the servicing and ground handling of aircraft.
- *2. CANCELLATION. Advisory Circular 00-34, dated April 12, 1972, is cancelled.
3. GENERAL. The aviation industry has found through experience that firm safety practices deter accidents. This advisory circular contains generally accepted information and safety practices which may help prevent injuries to personnel and damage to aircraft. Revised information regarding fueling procedures has been included. *
4. DIRECTING MOVEMENT OF AIRCRAFT. The person directing an aircraft that is being taxied should stay far enough ahead and to the left of the aircraft for the pilot to have an unobstructed view of him.
 - a. Use the standard hand signals illustrated in Figures 1 or 2, as applicable, of Appendix 1 of this circular.
 - b. When directing aircraft during darkness or inclement weather, the guideman should use illuminated or reflective wands.
 - c. Movement of aircraft in congested areas should be avoided. However, when necessary, additional guidemen should be stationed near the aircraft wing-tips to assure that adequate clearance is maintained.
5. PARKED AIRCRAFT. When an aircraft is parked, the main gear wheels should be chocked fore and aft. If the aircraft is to remain overnight or if winds are expected, flight control locks should be used.
 - a. While turbine-powered aircraft are not in service or being worked on, engine plugs should be installed to prevent damage from dust, debris, nesting birds, etc.

Initiated by: AFS-340

- b. Ground personnel should develop a habit of making a visual check of the aircraft as soon as it is parked and secured. Before the flight crew departs, advise them of any unsafe condition that may have been observed and determine the nature of services that will be required for the next flight. This procedure may prevent unwarranted delays of the next departure or possible in-flight failures. Examples of conditions that may be observed are: low or flat tires; cracked windows; nicked propeller blades; loose propeller spinners; oil and fuel leaks; damaged flight surfaces; etc.

CAUTION: Many people have been injured by propellers in a moment of carelessness. When it becomes necessary to position propellers, they should be handled as if the engine is going to start. Before moving a propeller, always check to be sure the ignition switches are in the "off" position, and the throttle and mixture control levers are in the "closed" position. Always stand clear of propeller blade path, particularly when moving the propeller, because of a possible inadvertent engine start. Particular caution should be practiced around warm engines.

6. TIE-DOWN OF AIRCRAFT. Information relating to aircraft tie-down techniques, equipment, and anchor installations is provided in Federal Aviation Administration Advisory Circular 20-35B, Tie-Down Sense. It is a good practice to always tie-down small aircraft after each flight and large aircraft when unusually high winds are expected. When not in use, wheel chocks, tie-down ropes, or chains, and other equipment, may be stored safely near the wing tie-down anchor points on the ramp. These are usually located outside of the aircraft wheel traffic pattern. Wheel chocks should be painted a bright color so they can be easily seen.
7. TOWING OF AIRCRAFT. When towing aircraft, the proper tow-bar must be used. The wrong type of tow-bar, or makeshift equipment, can cause damage to the aircraft. Persons performing towing operations should be thoroughly familiar with the procedures that apply to the type of aircraft to be moved. Particular care must be exercised when pulling or pushing an aircraft with a tow vehicle.
- a. One should never tow an aircraft in congested areas without guidemen to assist in determining that there is adequate clearance.
- b. No less than two people should be used to tow large aircraft, including a qualified person in the cockpit to operate the aircraft brakes, and a qualified tow vehicle operator. One man should be able to safely move a light aircraft with a hand-operated power-towing device or tow-bar provided for the aircraft.

- c. The man operating the tow vehicle should assure that the nose wheel scissors or tail wheel lock is disengaged, when applicable, before attempting to move the aircraft. He should also make certain that the nose wheel swiveling limits are not exceeded during the towing operation.
 - d. The aircraft engines should not, under normal circumstances, be operated during towing operations. However, the procedure of pushing transport aircraft away from terminal gates, used by airlines for dispatch, is an exception. If engines are operated during towing operations, procedures will be needed to keep personnel away from rotating propellers and away from the danger zones of jet engines.
 - e. Prior to movement of any aircraft, all landing gear struts and tires should be properly inflated and brake pressure built up when applicable.
 - f. The tow vehicle operator should avoid sudden starts and stops. The aircraft brakes should be applied only in an emergency, on command from the tow vehicle operator or his clearance man.
 - g. Clearance must be obtained from the airport control tower, either by appropriate radio frequency or by prior arrangement through other means, before moving aircraft across runways or taxiways.
8. TAXIING OF AIRCRAFT. Only rated pilots or other qualified persons should be authorized to taxi aircraft. Persons authorized to taxi aircraft should be familiar with the airport control communications procedures and radio frequencies.
9. AIRCRAFT FUELING. Improper fueling procedures may cause aircraft accidents and in-flight incidents. If operators of fueling facilities establish procedures for safe and proper fueling of aircraft and fueling personnel follow these procedures, many aircraft accidents or incidents will be prevented. Fueling personnel should be familiar with the fuel requirements for the models and types of aircraft they are servicing. The following paragraphs contain a description of problems that may be encountered in fueling aircraft and recommended procedures for combating these problems.
- a. Water in the Fuel.
 - (1) Water occurs in aviation fuels in three forms:
 - (a) Dissolved water occurs similar to the humidity in the atmosphere that converts to droplets and settles out as the fuel temperature decreases during flight.

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(b) Suspended water appears in the form of droplets that reflect light. High concentration of droplets will cause fuel to have a cloudy or hazy appearance.

(c) Solid bodies of water may be caused by leakage of storage tanks, leaking filler neck seals, or the settling out of suspended water droplets.

(2) Accumulation of water. There is no way of preventing the accumulation of water formed through condensation in fuel tanks. The accumulation is certain, and the rate of accumulation will vary; so it is recommended that storage tanks, fuel truck tanks and aircraft fuel tanks be checked DAILY for the presence of water. Any water discovered should be REMOVED immediately. In addition to the daily water check, fuel tanks should be CHECKED AFTER EACH DELIVERY as insurance against inadvertent water contamination.

(3) The minimum settling time. Adequate settling time is NECESSARY for accurate testing. The minimum settling time for aviation gas is 15 minutes per foot-depth of fuel and 60 minutes per foot-depth of turbine fuel.

(4) Water checks of storage tanks and fuel trucks may be made by attaching water detecting paste, or litmus paper, to the bottom of the tank dip stick.

(a) Push the dip stick to the bottom of the tank and hold for 30 seconds. When the stick is removed, the detecting paste or litmus paper will have changed color if water is present.

(b) The source of excessive amounts of water must be determined and corrected before further use of fuel from the tank.

b. Rust and scale dislodged from the inside of fuel storage tanks may enter the aircraft fuel tanks and clog systems. Turbine fuel tends to dislodge rust and scale and carry the particles in suspension. Because of this, fuel dispensing equipment filters should be serviced frequently. Aviation gasoline should not be stored in tanks or equipment that have been used for turbine fuel storage.

c. Micro-organic growth thrives in turbine fuel and appears as a soapy, slippery slime on the inside surfaces of fuel storage tanks. Micro-organisms of bacteria and fungi multiply rapidly and may cause serious corrosion in aircraft fuel tanks, as well as clog fuel filters, screens, and control units. Therefore, turbine fuel storage tanks should be checked frequently for the presence of slime or micro-organic growth. If found, the tank should be cleaned thoroughly to assure removal of the micro-organic growth and prevent further contamination.

- d. Dirt, lint, and dust may collect on fuel dispensing hose nozzles when proper storage receptacles are not used. Fuel hose nozzles should not be stored in such a manner that dirt or moisture will collect in them. Always check the nozzle for dirt and water before using it.
- e. Contamination with other types or grades of fuel can cause aircraft engine damage and possible failure in flight. Turbine fuels mixed with aviation gasoline reduce the antiknock and volatility of fuels required for reciprocating engines. Quantities of aviation gasoline mixed with turbine fuels will cause damaging lead deposits to collect in jet engines when used indiscriminately. Transportation or storage of turbine fuel in tanks previously used for storage or transportation of aviation gasoline is not recommended as contamination from rust and scale, or a possible change of fuel specification, may result.
- f. Additives. Certain turbine-engine-powered aircraft require the use of fuel containing anti-icing additives. Therefore, fuel personnel must know whether or not the fuels they dispense contain additives. When anti-icing additives are to be added to the fuel, the manufacturer's instructions (usually printed on the container) should be followed to assure proper mixture. Anti-icing additive content in excess of 0.15% by volume of fuel is not recommended as higher concentration can cause the aircraft fuel capacitance system to give erroneous indications. Concentrations of at least 0.05% additive by volume of fuel are effective in eliminating microbial growth.
- g. Fuel-Dispensing Equipment. Fuel-servicing vehicles should be conspicuously and legibly marked to indicate the type and grade of fuel.
 - (1) Markings should be displayed on each side and on the rear of the vehicle in CONTRASTING colors.
 - (2) Fuel hydrants and pit installations should be identified similarly, according to type of fuel and grade.
 - (3) Turbine-fueling vehicles should be marked to show whether or not anti-icing additives are contained in the fuel being dispensed.
 - (4) Leaking or otherwise defective pumping equipment, plumbing, hoses, nozzles, and grounding cables of fuel-dispensing vehicles and stationary facilities should be repaired before further use. Fuel-nozzle-lever stop notches should be removed to avoid the possibility of an inadvertent blocking-open of the valve.

- (5) Fuel-dispensing vehicles, and stationary facilities, should be equipped with appropriate fire extinguishers, fire blankets, static grounding cables, explosion proof flashlights, and ladders. Fire extinguishers should be located so they are accessible from either side of the vehicle and remote from probable fire hazard.
 - (6) Fueling vehicles should be positioned as distant from the aircraft as permitted by the length of the fuel dispensing hose. Mobile units should be parked parallel to or heading away from the aircraft wing leading edge, so it may be moved away quickly in the event of an emergency. When the fueling operation is completed, the fueling vehicle should be parked at least fifty feet from aircraft or buildings and positioned in a manner to permit removal from the area without delay.
- h. Fueling procedures. Fueling personnel should first check with the flight crew to determine the type and grade of fuel required, including additives for the aircraft. It is a good practice to have the pilot sign a request for service, identifying the grade and quantity of fuel desired. In the absence of the flight crew, fueling personnel should check the placard located near the aircraft fuel tank filler port, or the aircraft owner's manual that is usually carried in the aircraft, to determine the type and grade of fuel required.
- (1) Check to ensure that:
- (a) No electrical or radio equipment in the aircraft is energized or being maintained while fuel is being dispensed into the aircraft, except those switches that may require energizing to operate fuel selector valves and quantity gauge systems.
 - (b) Qualified personnel should be stationed at the aircraft fuel control panel during pressure fueling operations.
 - (c) Fueling personnel should not carry objects in the breast pockets of their clothing when servicing aircraft or filling fuel service vehicles because loose objects may fall into fuel tanks.
 - (d) Matches or lighters should never be carried during fueling operations.
 - * (e) Because of the high lead content, direct fuel contact with skin or the wearing of fuel saturated clothing should be avoided. Skin irritation or blisters may result from direct contact with fuel.
 - (f) Immediate medical attention should be sought if fuel enters the eyes.

- (g) In the event of fuel spillage, discontinue fueling operations until the spill can be removed, using proper safety precautions.
- (2) Fueling from mobile equipment. The following sequence should be followed by the fueling crew.

- (a) Connect a grounding cable from the fueling vehicle to a satisfactory ground. Grounding posts usually consist of pipes or rods driven far enough into the ground to result in a zero potential.

*

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- (b) Connect a ground cable from ground to the aircraft (on landing gear axle or other unpainted surface). Do not attach ground cables to the propeller or radio antenna.

- (c) Connect a grounding cable from the fueling vehicle to the aircraft. The fueling vehicle may be equipped with a "T" or "Y" cable permitting ground attachment first and grounding of the aircraft with the other end.

- (d) Connect a grounding cable from the fuel nozzle to the aircraft before removing the aircraft tank cap. This bond is most essential and needs to be maintained throughout the fueling operation and until the fuel cap is replaced.

CAUTION: Conductive-type fuel hose does not provide a satisfactory method of bonding.

- (e) The fuel-dispensing equipment grounding cables should be removed in the reverse order of the sequence outlined above.

- (3) Fueling from hydrants, pits, and cabinets.

- (a) Connect the grounding cable from the dispenser to the aircraft.

- (b) Connect the grounding cable from the hose nozzle to the aircraft before removing the fuel cap.

- (4) Overwing fueling. The fuel-filler hose should be draped over the wing leading edge. Never lay the fuel-filler hose over the wing trailing edge because aircraft structural damage may result. A simple rubber shower mat may be used to provide protection for wing leading edges during fuel operation. Step ladders or padded upright ladders may be used to provide easy access to high-wing and large aircraft. Standing on wing surfaces should be avoided and never stand on wing struts. Hold the fuel nozzle firmly while it is inserted in the fuel tank filler neck and never block the nozzle lever in the open position. Be sure that fuel filler caps are replaced and securely latched when fueling is completed.

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- (5) Underwing fueling. Discharge possible static buildup in the fuel dispensing hose by touching the pressure nozzle to an unpainted part of the aircraft, such as a landing gear axle, before attaching to the aircraft filler receptacle. No static ground wire between the filler nozzle and the aircraft is necessary.
- (6) The aircraft fuel tank sumps should be drained before each fuel servicing to remove water that may have accumulated from condensation or entered the tank during fueling operations. Draining fuel sumps immediately after fueling serves little purpose because the agitation action of fuel entering the tank may suspend water and contaminants - which can remain suspended for many minutes and may not settle out until the aircraft is airborne.

10. SERVICING OF OXYGEN SYSTEMS. Certain precautions should be observed whenever aircraft oxygen systems are to be serviced.

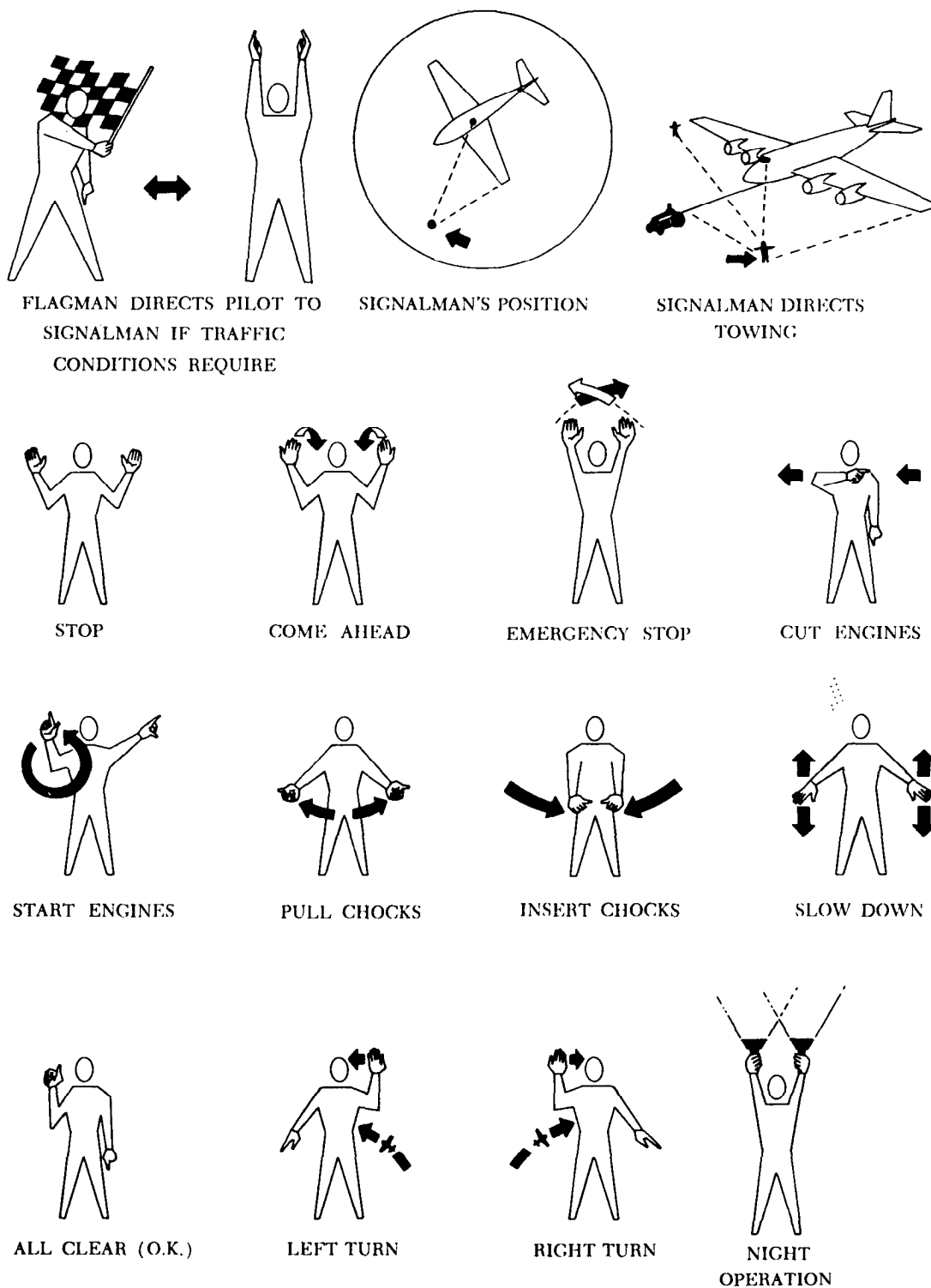
- a. Before servicing any aircraft with oxygen, consult the specific aircraft service manual to determine the type of equipment required and procedures to be used.
- b. Oxygen system servicing should be accomplished only when the aircraft is located outside of hangars.
- c. Personal cleanliness and good housekeeping are imperative when working with oxygen. Oxygen under pressure and petroleum products create spontaneous results when they are brought in contact with each other. Service people should be certain to wash oil and grease (including lip salves, hair oil, etc.), and dirt from their hands before working around oxygen equipment. It is also essential that clothing and tools are free of oil, grease, and dirt.
- d. Aircraft with permanently installed oxygen tanks usually require two persons to accomplish servicing of the system. One man should be stationed at the service equipment control valves, and the other stationed where he can observe the aircraft system pressure gauges.
- e. Oxygen system servicing is not recommended during aircraft fueling operations or while other work is performed that could provide a source of ignition.
- f. Oxygen system servicing while passengers are on board the aircraft is not recommended.


C. R. MELUGIN, JR.
Acting Director, Flight Standards Service

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AC 00-34 A
Appendix 1

FIGURE 1. AIRCRAFT OPERATING SIGNALS



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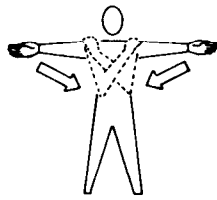
FIGURE 2. HELICOPTER OPERATING SIGNALS



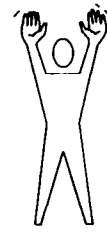
START ENGINE



ENGAGE ROTOR



STOP ROTOR



STOP



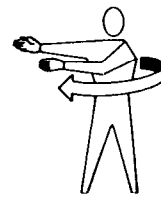
MOVE BACK



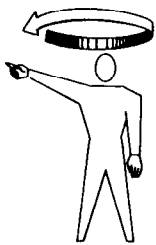
MOVE FORWARD



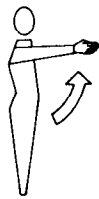
MOVE RIGHT



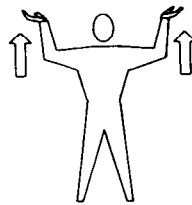
MOVE LEFT



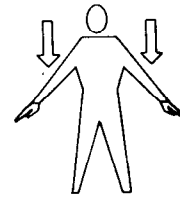
TAKE OFF



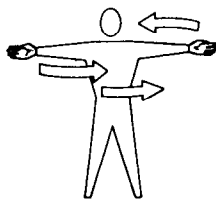
LANDING
DIRECTION



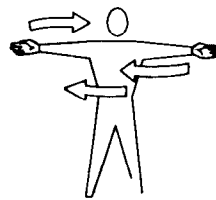
GO UP



GO DOWN



SWING TAIL
TO RIGHT

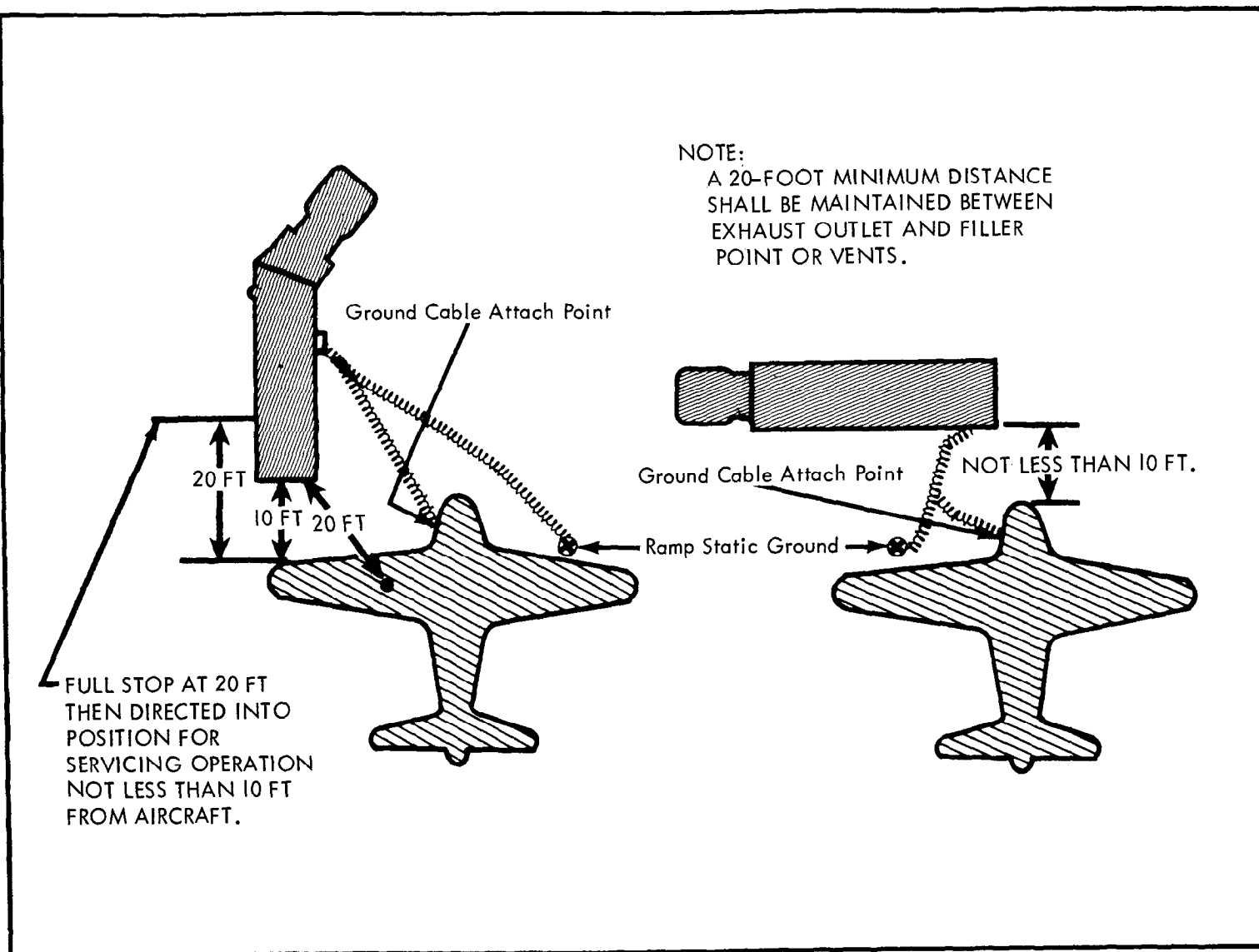


SWING TAIL
TO LEFT

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FIGURE 3 POSITIONING FUEL TRUCK

AC 00-34A
Appendix 1



AC NO: 20-43C

DATE: 10/20/76



ADVISORY CIRCULAR

**DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION**

SUBJECT: AIRCRAFT FUEL CONTROL



1. PURPOSE. This advisory circular alerts the aviation community to the potential hazards of inadvertent mixing or contamination of turbine and piston fuels, and provides recommended fuel control and servicing procedures.
2. CANCELLATION. Advisory Circular 20-43B, dated June 8, 1971, is canceled.
- * 3. REFERENCES. For more detail than is contained herein, see American Petroleum Institute Bulletins, Numbers 1523 Fourth Edition, 1542 Second Edition, 1581 First Edition, and the National Fire Protection Association Pamphlet "Aircraft Fuel Servicing 1975" and the American Society for Testing and Materials, "Standard Specification for Aviation Gasolines, D 910-75."

Initiated by: AFS-830

4. BACKGROUND. Since the introduction of jet aircraft fuel, there have been several instances of inadvertent fueling of piston-powered aircraft with jet fuel. Aviation fuel can only serve its ultimate purpose when the PROPER fuel is delivered into the aircraft as free from contamination as it was the day it left the refinery. Unless care and ATTENTION are given to its handling, servicing, and storage, the many precautions taken in its manufacture and transportation are wasted. Close attention to compatibility of fuel and aircraft, as well as faithful adherence to good housekeeping practices, is necessary to prevent possible disaster as well as costly contamination. A review of accidents attributed to fuel problems reveals that many power failures were due to use of improper fuel or careless servicing--fueling aircraft from poorly filtered tanks, particularly small tanks or drums, improper mixing of fuel additives, improper preflight action by the pilot, and storing aircraft with partially filled tanks, etc., which invites condensation and contamination of the fuel. It is well to remember that the consequences of using leaded gasoline in jet engines can be as damaging as the use of jet fuel in reciprocating engines.
5. TURBINE (JET) FUEL VERSUS GASOLINE. Investigation of a malfunctioning reciprocating engine disclosed that it had been inadvertently serviced with jet fuel. Examination of this engine revealed extensive cylinder assembly damage that required complete overhaul. Proper attention to refueling would have prevented this damage.

Frequency of improper fueling will diminish if owners, operators, and personnel servicing aircraft maintain vigilance. Should the occasion arise where the tanks in an aircraft are accidentally filled with jet fuel, it is suggested the following procedures be followed:

- a. If the engines were not operated subsequent to the refueling with jet fuel, drain the fuel tanks, lines, and system completely. Refill the tanks with the proper grade of aviation gasoline, and run the engines for approximately five minutes.
- b. If the engines were operated subsequent to the refueling with jet fuel, investigate any abnormal engine operating conditions such as those related to the fuel mixture and cylinder operating temperatures. In addition, accomplish the following:

- (1) Perform a compression test of all cylinders.
- (2) Completely borescope inspect the interior of cylinders, giving special attention to the combustion chamber and the piston dome.
- (3) Drain the engine oil and check the oil screens.

NOTE: When accomplishing (1), (2), and (3), further investigate and correct any unsatisfactory condition found.

- (4) Completely drain the fuel tanks and the entire fuel system including the engine carburetor.
- (5) Flush the fuel system and carburetor with gasoline and check for leaks.
- (6) Fill the fuel tanks with the proper grade of aviation gasoline.
- (7) If the engine inspection was satisfactory, complete an engine runup check.

- * 6. AVIATION GASOLINE GRADES AND COLOR CODES. Pilots and refueling personnel should be familiar with aviation gasoline (avgas) grades and respective color codes in order to assure proper servicing of engines. Three grades of avgas are now produced for civil use; grades 80, 100LL (low lead) and 100. These grades replace 80/87, 91/96, 100/130, and 115/145 avgas.
- a. The Standard Specification for Aviation Gasolines, Specification D 910-75, developed by the American Society for Testing and Materials, established that grade 80 should be red in color and contain 0.5 milliliters (ml.) maximum of tetraethyl lead per gallon. Grade 100LL is blue in color and contains 2.0 ml. maximum per gallon. Grade 100 is green in color and contains 3.0 ml. maximum per gallon (with a probable increase to 4.0 ml. maximum per gallon in the next specification revision). The lead quantity or concentration of lead in aviation gasoline is expressed in terms of milliliters (1/1000 of a liter) per gallon of avgas.

Grades 100LL and 100 represent two aviation gasolines which are identical in anti-knock quality but differ in maximum lead content and color. The color identifies the difference for those engines which have a low tolerance to lead.
 - b. Limited availability of grade 80 in some geographical areas of the country has forced owners/operators to use the next higher grade of avgas. Specific use of higher grades is dependent on the applicable manufacturer's recommendations. Continuous use of higher lead fuels in low compression engines designed for low lead fuels can cause erosion or necking of the exhaust valve stems and spark plug lead fouling *

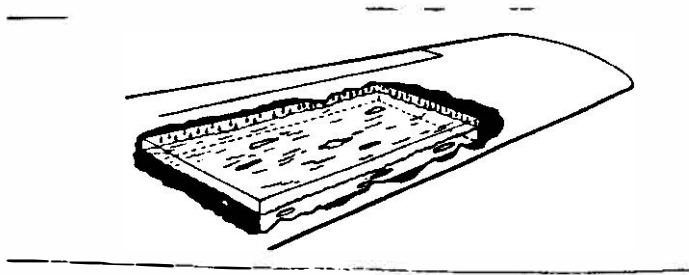
7. MARKING.

- a. Federal Aviation Regulations Part 23, Section 23.1557(c)(1), requires that aircraft fuel filler openings be marked to show the word "FUEL" and the minimum fuel grade or designation for the engines. In order that these markings retain their effectiveness, regulations also require that they be kept fresh and clean. It follows, therefore, that frequent washing and occasional painting will be necessary to retain clear legibility.
- b. It is equally important that tank vehicles be most conspicuously marked to show the type of fuel carried. It is suggested that the marking be of a color in sharp contrast to that of the vehicle and in lettering at least 12 inches tall. This marking should be on each side and on the rear of the tank vehicles. Additionally, it is suggested that the tank vehicle hose lines be marked by labels next to the nozzle and every six feet. The label lettering should be at least 3/4 inches in height, be of sharp color contrast, be permanently attached, and indicate the type of fuel dispensed by that hose. A further suggestion is that the refueling nozzles be conspicuously marked with the appropriate color code. This is especially important in that the person doing the refueling will have the color coded nozzle in his hands during the process with an additional reminder of the fuel type being dispensed. All of the afore-mentioned markings should be kept clean, fresh, and clearly legible at all times.

8. TRAINING. Careful instructions in operating procedures should be given to all personnel involved in fueling. This applies to flight as well as ground personnel. The ground personnel should be thoroughly indoctrinated in the facilities, procedures, equipment, and the types of fuel being dispensed--the flight personnel in procedures and marking with particular emphasis on use of the proper type of fuel. It is further suggested that ALL personnel be retrained periodically with suitable records maintained to reflect the training. Fuel servicing should be performed only by trained competent personnel.
9. WHAT IS FUEL CONTAMINATION? Fuel is contaminated when it contains any material that was not provided under the fuel specification. This material generally consists of water, rust, sand, dust, microbial growth, and certain additives that are not compatible with the fuel, fuel system materials and engines.

10. WHAT CAUSES FUEL CONTAMINATION?

- a. Water. All aviation fuels absorb moisture from the air and contain water in both suspended particle and liquid form. The amount of suspended particles varies with the temperature of the fuel. Whenever the temperature of the fuel is decreased, some of the suspended particles are drawn out of the solution and slowly fall to the bottom of the tank. Whenever the temperature of the fuel increases, water is drawn from the atmosphere to maintain a saturated solution. Changes in fuel temperature, therefore, result in a continuous accumulation of water. During freezing temperatures, this water may turn to ice, restricting or stopping fuel flow.



- b. Rust. Pipelines, storage tanks, fuel trucks, and drum containers tend to produce rust that can be carried in the fuel in small size particles. A high degree of filtration is required to remove the liquid water and rust particles from the fuel.
- c. Dust and sand. The fuel may be contaminated with dust and sand through openings in tanks and from the use of fuel-handling equipment that is not clean.
- d. Micro-organisms. Many types of microbes have been found in unleaded fuels, particularly in the turbine engine fuels. The microbes, which may come from the atmosphere or storage tanks, live at the interface between the fuel and liquid water in the tank. These micro-organisms of bacteria and fungi rapidly multiply and cause serious corrosion in tanks and may clog filters, screens, and fuel metering equipment. The growth and corrosion are particularly serious in the presence of other forms of contamination.
- e. Additives. Certain oil companies, in developing products to cope with aircraft fuel icing problems, found that their products also checked "bug" growth. These products, known as "biocides," are usually referred to as additives. Some additives may not be compatible with the fuel or the materials in the fuel system and may be harmful to other parts of the engine with which they come in contact. Additives that have not been approved by the manufacturer and FAA should not be used.

11. FIELD TESTS. Three gallons of water were added to the half-full fuel tank of a popular make, high-wing monoplane. After several minutes, the fuel strainer (gascolator) was checked for water. It was necessary to drain ten liquid ounces of fuel before any water appeared. This is considerably more than most pilots drain when checking for water.

In another test, simulating a tricycle geared model, one gallon of water was added to the half-full fuel tank. It was necessary to drain more than a quart of fuel before any water appeared.

In both of these tests, about nine ounces of water remained in the fuel tank after the belly drain and the fuel strainer (gascolator) had ceased to show any trace of water. This residual water could only be removed by draining the tank sumps.

12. CONTAMINATION CONTROL. The presence of any contamination in fuel systems is dangerous. Laboratory and field tests have demonstrated that when water was introduced into the gasoline tank, it immediately settled to the bottom. Fuel tanks are constructed with sumps to trap this water. It is practically impossible to drain all water from the tanks through the fuel lines, so it becomes necessary to regularly drain the fuel sumps in order to remove all water from the system. It may be necessary to gently rock the wings of some aircraft while draining the sumps to completely drain all the water. On certain tailwheel type aircraft, raising the tail to level flight attitude may result in additional flow of water to the gascolator or main fuel strainer. If left undrained, the water accumulates and will pass through the fuel line to the engine and may cause the engine to stop operating. The elimination of contaminants from aviation fuel may not be entirely possible, but we can control it by the application of good housekeeping habits.

- a. Servicing. Storage and dispensing equipment should be kept clean at all times--free from dirt and other foreign matter. Fuel having a "cloudy" appearance or definitely "offcolor" should be suspected of contamination or deterioration and should not be used. When additives are used, it is important that they are dispensed in accordance with the aircraft manufacturer's instructions.

Refueling from drums or cans should be considered as an unsatisfactory operation and one to be avoided whenever possible. All containers of this type are to be regarded with suspicion and the contents carefully inspected, identified, and checked for water and other contamination. Extraordinary precautions are necessary to eliminate the hazards of water and sediment. It is advisable when fueling from drums to use a 5-micron filtered portable pumping unit, or the best filtering equipment available locally, or, as a last resort, a chamois skin filter and filter funnel.

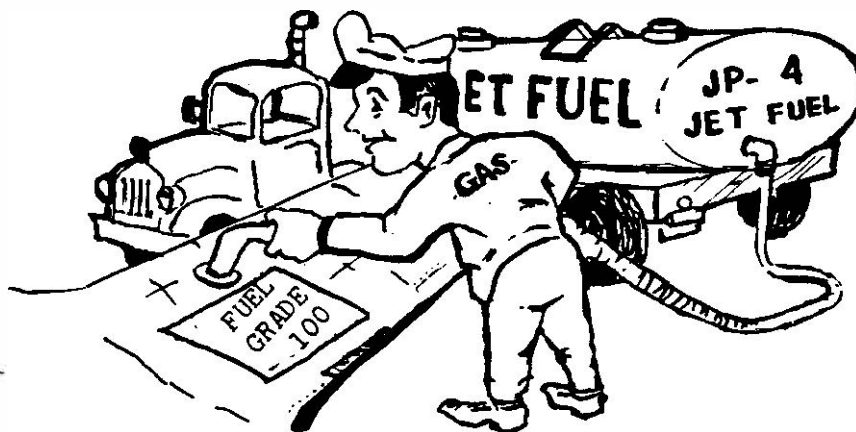
Infrequently used fuel tanks should have their sumps drained before filling. Agitation action of fuel entering the tank may suspend or entrain liquid water or other contaminants--which can remain suspended for many minutes and may not settle out until after the aircraft is airborne.

- b. Preflight action. Drain a generous sample of fuel--considerably more than just a trickle--into a transparent container from each of the fuel sumps and from the main fuel strainer or gascolator. (Remember that it was necessary to drain ten ounces in the field tests.) On certain aircraft having fuel tanks located in each wing, positioning of the fuel tank selector valve to the "BOTH ON" position may not adequately drain the system. This is due to the fuel taking the path of least resistance. In this case, the fuel selector valve should be positioned at each tank in turn.

Examine the fuel samples for water and dirt contamination. If present, it will collect at the bottom of the container and should be easily detected. Continue to drain fuel from the contaminated sump until certain the system is clear of all water and dirt.

"The use of quick-drain valves in the sumps and gascolator makes it practical to keep tanks free of significant quantities of water and other contaminants."

- c. Postflight. An effective method to prevent contamination from condensation would be to completely fill the fuel tank at the end of each day's flying. This procedure is practical only on a few types of light aircraft. Generally, the type of aircraft, length of proposed flight, number of passengers, and weight and balance limitations dictate the amount of fuel to be added.



WHAT'S WRONG WITH THIS PICTURE?

- d. Routine maintenance. In addition to the preflight and postflight actions, certain precautionary or routine maintenance should be performed on the aircraft at periodic intervals. These precautions include the inspection and cleaning of pertinent fuel tank outlet finger strainers and carburetor screens (filters), and flushing of the carburetor bowl.

13. JET FUELS. Turbine-powered aircraft, better known as "jet" or "prop jet," generally use a wide-cut gasoline or aviation kerosene as fuel. Basically, the same rules and precautions in handling aviation gasoline apply to the jet fuels. As with gasoline, we are concerned with the matter of cleanliness. Turbine fuels are more dense and have a greater viscosity (resistance to flow) than gasoline. It will hold and retain in suspension impurities such as water, fine particles of rust, and other foreign material. These particles can take from five to ten times as long, or even longer, to settle in kerosene as it does for them to settle in gasoline.

Turbine engine fuel controls and pumps are generally more sensitive than the fuel systems of the piston engine. Their fuel feed and pumping systems must work harder. Tolerances are closer and fuel pressures higher. Fine contaminants may block fuel supply systems and erode critical parts of engine and fuel control systems. Water freezing at high altitudes may plug fuel screens. Because of these, the tolerable contamination levels for jet fuels are much lower than previously considered necessary for aviation gasoline. Even with the same contamination levels, the greater volume of fuel used turbines results in greater amounts of contaminants being deposited in the turbine engine system.

- a. Test for contamination. Commercial products to test for fuel contamination are available. Here is a simple test to detect contamination of jet fuel. This procedure has proved to be both effective and inexpensive.



- Obtain an unchipped, spotlessly clean, white enamel bucket (approximately ten-quart size).
 - Drain about four to five inches of fuel, from the sump to be tested, into the bucket.
 - With a clean mixing paddle, stir the fuel into a swirling "tornado-shaped" cone. Remove paddle. As the swirling stops, the solid contaminants will gather at the center of the bucket bottom.
 - Add several drops of household red food dye. The dye will mix with water and the solids in the bottom of the bucket. It will not mix with fuel. If no water is present, the dye will settle in the bottom of the bucket.
14. CONTAMINATED FUEL. Normally, upon finding that your fuel is contaminated by water or other foreign matter, the procedures noted under paragraph 12, Contamination Control, should suffice. Should contamination persist, or if there is any doubt about it, your best bet is to have your aircraft fuel system inspected by a qualified person.



15. SUMMARY. So that your fuel system won't let you down when you want to stay up--remember:
- Turbine fuels for turbine engines--gasoline of the proper grade for reciprocating engines.
 - Use only the fuel recommended by the engine and aircraft manufacturer.
 - Don't use additives that have not been approved by FAA.

10/20/76

- If feasible, keep fuel tanks full. Water condenses on the walls of partially filled tanks and enters the fuel system.
- Filter all fuel entering the tank.
- Drain fuel sumps regularly.
- Periodically inspect and clean all fuel strainers (screens) and occasionally flush the carburetor bowl as recommended by the aircraft manufacturer.

The best insurance against fuel problems--whether aviation gasoline or jet fuel--is to practice good housekeeping in your routine maintenance and be constantly alert.



J.A. FERRARESE, Acting Director
Flight Standards Service



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: MARKING AIRCRAFT FUEL FILLER
OPENINGS WITH COLOR CODED DECALS

Date: 9/17/82
Initiated by: AWS-130

AC No: 20-116
Change:

1. PURPOSE. This Advisory Circular (AC) discusses the conditions under which color coded decals may be used to comply with the requirements in Parts 23, 25, 27, and 29 of the Federal Aviation Regulations for marking fuel filler openings

2. Related FAR Sections and Reading Material. Federal Aviation Regulations (FAR's) §§ 23.1557, 25.1557, 27.1557, 29.1557, and AC 20-43C, Aircraft Fuel Control, dated October 20, 1976.

3. BACKGROUND.

a. Aviation accident statistics compiled by the National Transportation Safety Board (NTSB) and the FAA indicate that a number of accidents have been caused by the use of improper fuel. Most of these accidents occur in general aviation operations and have been related to misfueling with a fuel not intended for use with that airplane. Misfueling a reciprocating engine powered aircraft with turbine fuel has had catastrophic results with engine failure occurring during the critical takeoff phase of flight. Several major fatal accidents occurred when transport airplanes were fueled with the wrong kind of fuel and crashed immediately after takeoff.

b. The General Aviation Manufacturers Association (GAMA) has proposed a method to minimize the misfueling of general aviation aircraft. A specification for a color coded decal has been developed (GAMA Specification No. 3 issued on July 1, 1982) to provide a standard for decals to be affixed adjacent to aircraft fuel filler ports to alert servicing personnel of the proper fuel to be used. This is part of an overall scheme of color matching decals at aircraft fuel filler ports and fuel filler nozzles.

4. DISCUSSION. Color coded decals meeting the material requirements, test conditions, and application and removal requirements for decals in GAMA Specification No. 3 are acceptable for use on small airplanes, transport airplanes and helicopters under the following conditions:

a. The color coded decal may be affixed to any certificated airplane or helicopter as an additional fuel filler marking as long as the required fuel filler markings approved for that airplane or helicopter are retained and the information on the color coded decal does not conflict with the information provided under the certification basis.

b. The color coded decal may be used to show compliance with the fuel filler marking requirements of FAR's §§ 23.1557, 25.1557, 27.1557, and 29.1557 in the certification of reciprocating engine powered airplanes and helicopters provided that the decal contains all of the information required by the regulations applied during the airplane or helicopter certification. Additional information such as "useable fuel capacity" may be required under the airplane or helicopter certification basis. Any information that is required to supplement the information on the color coded decal must be marked in an acceptable manner at or near the filler cover. The term "Avgas" on the decal is considered to be equivalent to the word "Fuel" specified in the regulations.

c. The color coded decal may be used to supplement the markings provided to show compliance with the fuel filler marking requirements of FAR's §§ 23.1557, 25.1557, 27.1557, and 29.1557 in the certification of turbine engine powered airplanes and helicopters. Such information as fuel designation, fuel additives, and maximum permissible fueling and defueling pressures which may be required by the applicable regulations, must be marked in an acceptable manner at or near the filler cover.



M. C. Beard
Director of Airworthiness



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject:
ANTI-MISFUELING DEVICES:
THEIR AVAILABILITY AND USE

Date: 1/29/91
Initiated by: AFS-340

AC No: 20-122A
Change:

1. PURPOSE. This **advisory** circular (AC) explains the benefits of fitting reciprocating engine-powered general aviation aircraft with **anti-misfueling** devices and the fitting of fuel dispensing equipment with special fuel hose nozzle **spouts**.

2. CANCELLATION. AC 20-122, **Anti-misfueling** Devices: Their Availability and Use, dated October 5, 1984, is cancelled.

3. RELATED FEDERAL AVIATION REGULATIONS (FAR) SECTIONS. FAR Sections 23.1557, 27.1557, 43.3, 91.3(a), 91.5, and 139.321.

4. RELATED READING MATERIAL. AC 00-34A, Aircraft Ground Handling and Servicing; AC 20-43C, Aircraft Fuel Control; AC 20-116, Marking Aircraft Fuel Filler Openings With Color Coded Decals; and AC 150/5230-4, Aircraft Fuel Storage, Handling, and Dispensing on Airports.

5. BACKGROUND.

a. Aviation statistics indicate that the use of improper fuel has caused or contributed to an inordinate number of accidents and incidents. Most of these have involved single-engine general aviation aircraft (and some multiengine) that were **misfueled** with jet or turbine engine fuel instead of gasoline which these aircraft use. **Misfueling** a reciprocating engine-powered aircraft with jet or turbine engine fuel can and has produced catastrophic results when engines failed during the critical takeoff phase of flight.

b. A specification developed by the General Aviation Manufacturers Association (**GAMA**), Specification No. 3 issued on July 1, 1982, provides a standard color coded decal to be affixed adjacent to aircraft fuel tank filler openings and corresponding color decal bands **to** be affixed to **refuelers'** fuel hoses. Both decals were designed to alert servicing personnel as to the proper fuel to be used.

c. The National Air Transportation Association (**NATA**) and **GAMA** are cooperating in an additional effort which will significantly mitigate the chances of **misfueling**. Fuel tank filler openings in reciprocating engine-powered aircraft may be equipped with pilot-installed adapter rings reducing the opening size from 3" to 2.3" in diameter. Jet or turbine engine fuel nozzle assemblies will be equipped with spouts with a minimum diameter of 2.6", thereby reducing the probability of introducing jet or turbine engine fuel nozzles into the filler openings of aircraft requiring gasoline.

6. DISCUSSION.

a. The down-size adapter rings are being made available through the aircraft **manufacturers'** original equipment manufacturer (**OEM**). Individual OEM's have developed, or are developing, **service information** for each conversion kit to ensure proper type and installation. Owners and operators of reciprocating engine-powered aircraft should seriously consider equipping each fuel tank **filler** opening with these adapters since safety will be significantly enhanced, and in some cases, the cost is being defrayed by insurance companies. Check with your aircraft manufacturer or insurance company to determine its participation. Since January **1, 1985**, all **GAMA** member companies' newly-produced airplanes have fueling ports that meet the dimensions defined in the Society of Automotive Engineers' (**SAE**) Aerospace Standard (**AS**) **1852**.

b. Fuel tank filler opening adapters may be installed by pilots only **when** accomplished in accordance with **OEM service** information. Consistent **with FAR** Section **43.3(g)**, the fuel tank filler opening adapters may be installed **by** at least a certificated pilot. The installations must be approved for **return** to service under Section **43.7** and recorded as required by Section **43.9(a)**.

Note: The installation of these adapters may be performed on an aircraft owned or operated by the holder of a pilot certificate issued under **Part 61**, as long as the aircraft is not used under **Parts 121**, or **135**.

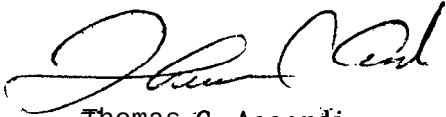
c. In the interest of safety and standardization, it is recommended that Fixed Base Operators (**FBO**) and other aviation fuel suppliers equip their turbine fueling equipment (trucks, islands, pumps, etc.) with the larger size nozzles designated in **SAE AS 1852** to prevent **misfueling** reciprocating engined aircraft with turbine fuel. **SAE AS 1852** defines maximum free opening dimensions for airframe refueling ports on civil aircraft that require the exclusive use of aviation gasolines, and minimum free opening dimensions for airframe refueling ports on civil aircraft that operate with turbine fuels as a primary type fuel. In addition, the aerospace standard defines the minimum refueling nozzle tip dimensions for turbine fuel ground service equipment and the maximum refueling nozzle tip diameter dimension for aviation gasoline ground service equipment.

d. Airport owners should amend their airport operations manual to **encourage FBO's** and other suppliers to meet the new size specifications for jet fuel nozzle spouts, and to do so within a specified time period.

1/29/91

AC 20-122A

e. For more information, interested parties should contact the manufacturer of their aircraft or General Aviation Manufacturers Association, 1400 K Street NW., Suite 801, Washington, D.C. 20005, telephone (202) 393-1500; National Air Transportation Association, 4226 King Street, Alexandria, Virginia 22303, telephone (703) 845-9000; or the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pennsylvania 15096, telephone (412) 776-4841.



Thomas C. Accardi
Acting Director, Flight Standards Service

Par 6

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Advisory Circular

Subject:
ANTI-MISFUELING DEVICES:
THEIR AVAILABILITY AND USE

Date: 1/29/91
Initiated by: AFS-340

AC No: 20-122A
Change:

1. PURPOSE. This **advisory** circular (AC) explains the benefits of fitting reciprocating engine-powered general aviation aircraft with **anti-misfueling** devices and the fitting of fuel dispensing equipment with special fuel hose nozzle **spouts**.

2. CANCELLATION. AC 20-122, **Anti-misfueling** Devices: Their Availability and Use, dated October 5, 1984, is cancelled.

3. RELATED FEDERAL AVIATION REGULATIONS (FAR) SECTIONS. FAR Sections 23.1557, 27.1557, 43.3, 91.3(a), 91.5, and 139.321.

4. RELATED READING MATERIAL. AC 00-34A, Aircraft Ground Handling and Servicing; AC 20-43C, Aircraft Fuel Control; AC 20-116, Marking Aircraft Fuel Filler Openings With Color Coded Decals; and AC 150/5230-4, Aircraft Fuel Storage, Handling, and Dispensing on Airports.

5. BACKGROUND.

a. Aviation statistics indicate that the use of improper fuel has caused or contributed to an inordinate number of accidents and incidents. Most of these have involved single-engine general aviation aircraft (and some multiengine) that were **misfueled** with jet or turbine engine fuel instead of gasoline which these aircraft use. **Misfueling** a reciprocating engine-powered aircraft with jet or turbine engine fuel can and has produced catastrophic results when engines failed during the critical takeoff phase of flight.

b. A specification developed by the General Aviation Manufacturers Association (**GAMA**), Specification No. 3 issued on July 1, 1982, provides a standard color coded decal to be affixed adjacent to aircraft fuel tank filler openings and corresponding color decal bands **to** be affixed to **refuelers'** fuel hoses. Both decals were designed to alert servicing personnel as to the proper fuel to be used.

c. The National Air Transportation Association (**NATA**) and **GAMA** are cooperating in an additional effort which will significantly mitigate the chances of **misfueling**. Fuel tank filler openings in reciprocating engine-powered aircraft may be equipped with pilot-installed adapter rings reducing the opening size from 3" to 2.3" in diameter. Jet or turbine engine fuel nozzle assemblies will be equipped with spouts with a minimum diameter of 2.6", thereby reducing the probability of introducing jet or turbine engine fuel nozzles into the filler openings of aircraft requiring gasoline.

6. DISCUSSION.

a. The down-size adapter rings are being made available through the aircraft **manufacturers'** original equipment manufacturer (**OEM**). Individual OEM's have developed, or are developing, **service information** for each conversion kit to ensure proper type and installation. Owners and operators of reciprocating engine-powered aircraft should seriously consider equipping each fuel tank **filler** opening with these adapters since safety will be significantly enhanced, and in some cases, the cost is being defrayed by insurance companies. Check with your aircraft manufacturer or insurance company to determine its participation. Since January **1, 1985**, all **GAMA** member companies' newly-produced airplanes have fueling ports that meet the dimensions defined in the Society of Automotive Engineers' (**SAE**) Aerospace Standard (**AS**) **1852**.

b. Fuel tank filler opening adapters may be installed by pilots only **when** accomplished in accordance with **OEM service** information. Consistent **with FAR** Section **43.3(g)**, the fuel tank filler opening adapters may be installed **by** at least a certificated pilot. The installations must be approved for **return** to service under Section **43.7** and recorded as required by Section **43.9(a)**.

Note: The installation of these adapters may be performed on an aircraft owned or operated by the holder of a pilot certificate issued under **Part 61**, as long as the aircraft is not used under **Parts 121**, or **135**.

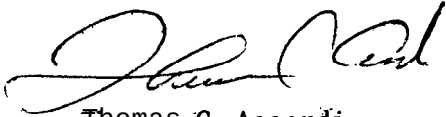
c. In the interest of safety and standardization, it is recommended that Fixed Base Operators (**FBO**) and other aviation fuel suppliers equip their turbine fueling equipment (trucks, islands, pumps, etc.) with the larger size nozzles designated in **SAE AS 1852** to prevent **misfueling** reciprocating engined aircraft with turbine fuel. **SAE AS 1852** defines maximum free opening dimensions for airframe refueling ports on civil aircraft that require the exclusive use of aviation gasolines, and minimum free opening dimensions for airframe refueling ports on civil aircraft that operate with turbine fuels as a primary type fuel. In addition, the aerospace standard defines the minimum refueling nozzle tip dimensions for turbine fuel ground service equipment and the maximum refueling nozzle tip diameter dimension for aviation gasoline ground service equipment.

d. Airport owners should amend their airport operations manual to **encourage FBO's** and other suppliers to meet the new size specifications for jet fuel nozzle spouts, and to do so within a specified time period.

1/29/91

AC 20-122A

e. For more information, interested parties should contact the manufacturer of their aircraft or General Aviation Manufacturers Association, 1400 K Street NW., Suite 801, Washington, D.C. 20005, telephone (202) 393-1500; National Air Transportation Association, 4226 King Street, Alexandria, Virginia 22303, telephone (703) 845-9000; or the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pennsylvania 15096, telephone (412) 776-4841.



Thomas C. Accardi
Acting Director, Flight Standards Service

Par 6

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Advisory Circular

Subject: Anti-Misfueling Devices: Their Availability
and Use

Date: 11/17/16

AC No: 20-122A

Initiated by: AFS-300

Change: 1

1. PURPOSE. This advisory circular (AC) explains the benefits of fitting reciprocating engine-powered general aviation aircraft with devices and the fitting of fuel dispensing equipment with special fuel hose nozzle spouts.

2. PRINCIPAL CHANGES. This AC incorporates minor changes to paragraphs 3 and 7.5.

PAGE CONTROL CHART

Remove Pages	Dated	Insert Pages	Dated
Page 1	1/29/91	Page 1	11/17/16
Page 3	1/29/91	Page 3	11/17/16

John S. Duncan
Director, Flight Standards Service



**U.S. Department
of Transportation**
Federal Aviation
Administration

Advisory Circular

Subject: Anti-Misfueling Devices: Their
Availability and Use

Date: 11/17/16

AC No: 20-122A

Initiated by: AFS-300

Change: 1

- 1 **PURPOSE.** This advisory circular (AC) explains the benefits of fitting reciprocating engine-powered general aviation aircraft with devices and the fitting of fuel dispensing equipment with special fuel hose nozzle spouts.
- 2 **CANCELLATION.** AC 20-122, Anti-Misfueling Devices: Their Availability and Use, dated October 5, 1984, is cancelled.
- 3 **AUDIENCE.** This AC applies to all persons involved in aircraft refueling, defueling, servicing, and maintaining fuel dispensing equipment. All involved are strongly encouraged to review the information in this AC and apply the techniques, as appropriate.
- 4 **REGULATIONS.**
 - 4.1 **Title 14 of the Code of Federal Regulations (14 CFR):**
 - Part 23, § 23.1557;
 - Part 27, § 27.1557;
 - Part 43, §§ 43.3 and 43.5;
 - Part 91, §§ 91.3(a) and 91.5; and
 - Part 139, § 139.321.
- 5 **RELATED READING MATERIAL (current editions).**
 - AC 00-34, Aircraft Ground Handling and Servicing;
 - AC 20-43, Aircraft Fuel Control;
 - AC 20-116, Marking Aircraft Fuel Filler Openings With Color Coded Decals; and
 - AC 150/5230-4, Aircraft Fuel Storage, Handling, and Dispensing on Airports.
- 6 **BACKGROUND.**
 - 6.1 Aviation statistics indicate that the use of improper fuel has caused or contributed to an inordinate number of accidents and incidents. Most of these have involved single-engine general aviation aircraft (and some multiengine) that were misfueled with jet or turbine engine fuel instead of gasoline, which these aircraft use. Misfueling a reciprocating

engine-powered aircraft with jet or turbine engine fuel can and has produced catastrophic results when engines failed during the critical takeoff phase of flight.

- 6.2 A specification developed by the General Aviation Manufacturers Association (GAMA), Specification No. 3, issued on July 1, 1982, provides a standard color-coded decal to be affixed adjacent to aircraft fuel tank filler openings and corresponding color decal bands to be affixed to refuelers' fuel hoses. Both decals were designed to alert servicing personnel as to the proper fuel to be used.
- 6.3 The National Air Transportation Association (NATA) and GAMA are cooperating in an additional effort which will significantly mitigate the chances of misfueling. Fuel tank filler openings in reciprocating engine-powered aircraft may be equipped with pilot-installed adapter rings reducing the opening size from 3 inches to 2.3 inches in diameter. Jet or turbine engine fuel nozzle assemblies will be equipped with spouts with a minimum diameter of 2.6 inches, thereby reducing the probability of introducing jet or turbine engine fuel nozzles into the filler openings of aircraft requiring gasoline.

7 DISCUSSION.

- 7.1 The down-size adapter rings are being made available through the aircraft manufacturers' Original Equipment Manufacturer (OEM). Individual OEMs have developed, or are developing, service information for each conversion kit to ensure proper type and installation. Owners and operators of reciprocating engine-powered aircraft should seriously consider equipping each fuel tank filler opening with these adapters since safety will be significantly enhanced, and in some cases, the cost is being defrayed by insurance companies. Check with your aircraft manufacturer or insurance company to determine its participation. Since January 1, 1985, all GAMA member companies' newly produced airplanes have fueling ports that meet the dimensions defined in SAE Aerospace Standard (AS) 1852.
- 7.2 Fuel tank filler opening adapters may be installed by pilots only when accomplished in accordance with OEM service information. Consistent with § 43.3(g), the fuel tank filler opening adapters may be installed by at least a certificated pilot. The installations must be approved for return to service under § 43.7 and recorded as required by § 43.9(a).

Note: The installation of these adapters may be performed on an aircraft owned or operated by the holder of a pilot certificate issued under 14 CFR part 61, as long as the aircraft is not used under 14 CFR part 121, 129, or 135.

- 7.3 In the interest of safety and standardization, it is recommended that Fixed-Base Operators (FBO) and other aviation fuel suppliers equip their turbine fueling equipment (trucks, islands, pumps, etc.) with the larger size nozzles designated in SAE AS 1852 to prevent misfueling reciprocating engine aircraft with turbine fuel. SAE AS 1852 defines maximum free opening dimensions for airframe refueling ports on civil aircraft that require the exclusive use of Aviation Gasolines (AVGAS), and minimum free opening dimensions for airframe refueling ports on civil aircraft that operate with turbine fuels as a primary type fuel. In addition, the AS defines the minimum refueling nozzle tip

dimensions for turbine fuel ground service equipment and the maximum refueling nozzle tip diameter dimension for AVGAS ground service equipment.

- 7.4** Airport owners should amend their airport operations manual to encourage FBOs and other suppliers to meet the new size specifications for jet fuel nozzle spouts, and to do so within a specified time period.
- 7.5** For more information, interested parties should contact the manufacturer of their aircraft or the General Aviation Manufacturers Association, 1400 K Street NW., Suite 801, Washington, DC 20005, telephone: (202) 393-1500; the National Air Transportation Association, 818 Connecticut Avenue NW, Suite 900, Washington, DC 20006, telephone: (203) 774-1535 or toll-free at (800) 808-6282; or the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096, telephone: (724) 772-8572.

Advisory Circular Feedback Form

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by contacting the Flight Standards Directives Management Officer at 9-AWA-AFS-140-Directives@faa.gov.

Subject: AC 20-122A CHG 1, Anti-Misfueling Devices: Their Availability and Use

Date: _____

Please check all appropriate line items:

☐ An error (procedural or typographical) has been noted in paragraph _____ on page _____.

☐ Recommend paragraph _____ on page _____ be changed as follows:

☐ In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

☐ Other comments:

☐ I would like to discuss the above. Please contact me.

Submitted by: _____

Date: _____



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: Aircraft Fuel Storage, Handling,
Training, and Dispensing on Airports

Date: 9/28/2012

AC No: 150/5230-4B

Initiated by: AAS-300 **Change:**

1. Purpose. This advisory circular (AC) contains specifications and guidance for the storage, handling, and dispensing of aviation fuel on airports. Additionally, this AC provides standards and guidance for the training of personnel who conduct these activities.

2. Cancellation. This AC cancels AC 150/5230-4A, Aircraft Fuel Storage, Handling, and Dispensing on Airports, dated June 18, 2004.

3. Application. This AC provides an acceptable means of complying with Title 14 Code of Federal Regulations (CFR) part 139 (hereinafter referred to as Part 139) for all Part 139 airport operators. Although non-certificated airports are not required to develop fuel standards, the FAA recommends these airports use the guidance contained in this AC to develop such standards for the continued enhancement of aviation safety.

4. Addendum of Authorized Fuel Safety Training Courses. The Federal Aviation Administration (FAA) regards instructional programs that provide line service and supervisory training, as required by 14 CFR §139.321 (e) (1) and (2), as critical to safety on airports.

To ensure this training is complete and effective, the FAA has determined that:

a. Third-party training providers who provide line service training and/or supervisory training of line service personnel must submit their training syllabus to the Administrator for review and a determination of its acceptability.

b. Airport and Tenant Fueling Agents who provide line service training for other than their own airport employees and/or supervisory training of line service personnel must submit their training syllabus to the Administrator for review and a determination of its acceptability.

c. Training syllabus (syllabi) should be submitted to:

Federal Aviation Administration
Manager, Airport Safety and Operations
Attn: Fuel Safety Training
800 Independence Ave SW
AAS-300, Room 618
Washington DC 20591

The FAA publishes a list of the companies offering courses of instruction in line service training as well as supervisory training that are acceptable to the Administrator. Because changes may occur more frequently than the schedule for updating the AC, the FAA will review this list on a quarterly basis and post an updated version online as an **Addendum** to this AC.

The airport operator is responsible for consulting the current listing of acceptable training courses. Likewise, the companies listed in this Addendum are responsible for notifying the FAA of any changes to their training syllabus and the availability of the course(s) offered or to contact information.

5. Effective Date. The effective date of this AC is September 28, 2012.

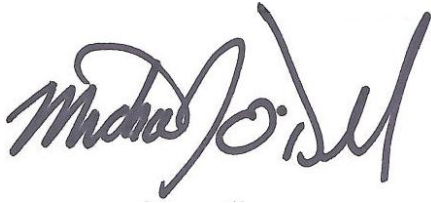
6. Comments or Suggestions. Send suggestions for improving this AC to:

Federal Aviation Administration
Manager, Airport Safety and Operations
Attn: Fuel Safety Training
800 Independence Ave SW
AAS-300, Room 618
Washington DC 20591

7. Principal Changes. This AC contains:

- a. New Chapter 1, Standards and Resources for Procedures on Fuel Storage, Handling, and Dispensing
- b. New Chapter 2, Fuel Safety Training
- c. New Chapter 3, Supervisors Training Course
- d. New Chapter 4, Testing, Certification and Recordkeeping
- e. New Chapter 5, Guidelines for Submitting Line Service and/or Supervisory Safety Course(s)
- f. New Addendum of Authorized Fuel Safety Training Courses
- g. New Appendix A, Definitions and Acronyms
- h. New Appendix B, Additional Resources
- i. Required wording differentiating the two levels of Fuel Safety Training

8. Copies of this AC. The FAA makes this AC and the current Addendum of training courses available online at http://www.faa.gov/regulations_policies/advisory_circulars/.

A handwritten signature in dark ink, appearing to read "Michael J. O'Donnell". The signature is stylized with a large, looping "M" and a long, sweeping "O".

Michael J. O'Donnell
Director, Office of Airport Safety and Standards

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Chapter 1. Standards and Resources for Procedures on Fuel Storage, Handling, and Dispensing

1. Introduction. Many standards and resources exist throughout the fueling industry to provide guidance on the proper and safe method for handling aviation fuels.

2. Standards. The FAA uses the standards contained in the most recent edition of National Fire Prevention Association (NFPA) 407, Standard for Aircraft Fuel Servicing. NFPA 407 provides a standard for the storage and delivery of aviation fuel in an airport environment..

3. Copies of Standards. You can order NFPA 407 from:

National Fire Protection Association
1 Batterymarch Park
PO Box 9101
Quincy MA 02269-9101
1-800-344-3555
<http://www.nfpa.org>

NFPA 407 may also be viewed online from the NFPA website as a read-only document at:
<http://www.nfpa.org/aboutthecodes/AboutTheCodes.asp?DocNum=407>.

Chapter 2. Fuel Safety Training

This chapter provides guidance on the development of **both** the supervisory fuel safety and the line service fuel safety training courses. Based on the minimum standards established in 14 CFR §139.321 (b) (1) – (7) and §139.321 (e), this chapter identifies the areas that must be addressed in these courses. **Because of the responsibilities inherent in training others in fire safety, this AC identifies in Chapter 3 further areas of competence that must be met for the Supervisory Training Course.**

1. Introduction.

a. 14 CFR §139.321 sets forth the requirements for fuel safety training at certificated airports. These requirements include two distinct types of training for employees of agents handling aviation fuel: supervisory training and line service fuel safety training. Training performed under the supervisory training program must be obtained by completing a FAA authorized Supervisory Fuel Safety training course. Line service fuel safety training for other employees may be provided by a supervisor who has completed the supervisory course or an authorized fuel safety training program. The material and program utilized by a certified supervisor to provide training to their company employees does not need to be reviewed or approved by the FAA. Training for employees may also be completed through the use of an approved line service fuel safety course. Using an approved line service fuel safety course does not relieve a fueling agent from the obligation to have at least one supervisor complete a supervisory fire safety course.

b. Incidents and accidents caused by the mishandling of fuels and other hazardous materials are vital concerns of both the FAA and airport operators. Additionally, the FAA and other local and federal agencies are concerned with activities related to conditions that lead to personnel injuries and damage to property as well as those attributable to insufficient attention to the impacts that fuel and lubricant products have on the environment when they are not used properly. For these reasons, airports certificated under Part 139 must ensure training is received in the areas listed in 14 CFR §139.321 (b) for personnel whose duties and responsibilities involve the handling and storing of hazardous substances and materials.

c. Part 139.321(e) (1) requires that “[at] least one supervisor with each fueling agent must have completed an aviation fuel training course in fire safety that is authorized by the Administrator. Such an individual must be trained prior to initial performance of duties, or enrolled in an authorized aviation fuel training course that will be completed within 90 days of initiating duties, and receive recurrent instruction at least every 24 consecutive calendar months.”

d. Part 139.321(e) (2) requires “[a]ll other employees who fuel aircraft, accept fuel shipments, or otherwise handle fuel must receive at least initial on-the-job training and recurrent instruction every 24 consecutive calendar months in fire safety from the supervisor trained in accordance with paragraph (e) (1) of this section.” Training for employees may also be completed through the use of an approved line service fuel safety course. The FAA lists supervisory and line service programs currently available nationally in the Addendum, which is updated quarterly. It can be found along with this AC on the FAA’s website.

e. 14 CFR §139.321 (b) places the responsibility of determining standards for fueling safety on the individual airport based on state, local, or municipality fueling regulations. The FAA does not intend this AC to replace airport procedures that are tailored to meet requirements imposed because of the use of special equipment or as a result of local regulations.

f. This AC provides guidelines in Chapter 5 for submitting a supervisory and/or a line service fueling safety program to the FAA for national acceptance.

2. Mandatory Elements for Supervisory and Line Service Fuel Safety Training Programs.

A fuel safety training program should include:

a. An orientation that addresses:

- (1) Purpose of the course
- (2) Expected outcomes as identified in 14 CFR §139.321
- (3) Familiarity with applicable FAA ACs, fire codes, and fire and fuel safety organizations and their publications
- (4) Knowledge of fuel types
- (5) Fueling of different types of aircraft
- (6) Supervisory Requirement - An overview of techniques for effective training, including:
 - i. Methods of delivery; Classroom, On-the-Job and Online
 - ii. Understanding of different types of learning (i.e. visual, cognitive, hands-on)
 - iii. Motivational aspects of training

b. Basic safety practices including:

- (1) Protection against fire and explosions
- (2) Safe handling and storage procedures for fuels and lubricants
- (3) An understanding of the term “hazardous materials” and procedures for handling hazardous materials and other fuels and lubricants
- (4) Use of Personal Protective Equipment (PPE) , including eye protection, ear protection, hand protection, and proper types of clothing and shoes/boots
- (5) Prohibition on carriage of smoking materials (i.e., cigars, cigarettes, lighters, matches, and pipes)

(6) First aid for responding to contact with aviation fuels or lubricants, including ingestion, inhalation, and contact with eyes or bare skin

c. Bonding

- (1) Definitions as contained in NFPA 407
- (2) Physics of bonding (what/when/why)
- (3) How to ground versus how to bond:
 - i. Where and how to bond
 - ii. Types of bonding equipment
 - iii. Correct bonding procedures
- (4) Static electricity
- (5) Fuel flash points

d. Public protection

- (1) Protection from sources of ignition
- (2) Proper ramp fueling procedures, including aircraft with passengers on board
- (3) Coordination with flight crew prior to fueling aircraft
- (4) Situations requiring cessation of fueling procedures

e. Control of access to storage areas

- (1) Fences and gates/locks
- (2) Signs and other required placarding (e.g., “No smoking,” “Jet A,” “AVgas”)
- (3) Protection and security associated with fuel farms, including proper authorizations and procedures
- (4) Safety awareness (location and operation of fire extinguishers, location of emergency shutoffs, communications for assistance)

f. Fire safety in fuel farm and storage areas

- (1) Verification of product types
- (2) Fuel farm inspection procedures

- (3) Fueling operations at fuel storage facilities during low visibility and night operations
 - (4) Fuel delivery operations, including the use of hoses, valves, and other equipment
 - (5) Proper procedures for fuel equipment use/storage (nozzle covers, securing of equipment when not in use)
 - (6) Leak and spill prevention
 - (7) Product leaks and contamination
 - (8) Emergency procedures and notifications
 - i. Local spill reporting procedures
 - ii. Spill control and containment (limited quantity)
 - iii. Spill (large quantity) and aircraft rescue and firefighting notification
 - iv. Cleanup procedures
 - (9) Fire classification and appropriate types of extinguishers
 - i. Fire classifications and extinguisher types used
 - ii. Inspections, safety, and personnel protection after a spill
 - iii. Hands-on training in use of a portable fire extinguisher (see section 4)
 - (10) Effects of weather on fueling operations
- g. Fire safety in mobile fuelers, fueling pits, and fueling cabinets**
- (1) Weight and balance, driving requirements, speed precautions, and driver qualifications
 - (2) Inspection of fueling vehicle and the sumping, exhaust, and muffler system
 - (3) Procedures and vehicle placement for fueling operations, controls, interlocks, brakes, and chocking
 - (4) Mobile fueler refueling procedures
 - (5) Parking requirements and separation distances
 - (6) Fueling pit safety/procedures/product leaks/clean-up

(7) Fueling cabinet safety procedures

h. Fire code requirement – supervisory personnel requirement (see section 3)

3. Local Fire Codes and Regulations. A local fire code or the National Fire Code may be the governing document at specific airport(s). This information must be included in the course(s). Supervisory personnel must be informed of their responsibility to determine the code that appropriately governs the airport at which they provide and conduct fueling activities. They must ensure code information is incorporated into their line service personnel training. It is their responsibility to receive a briefing on local fire codes from airport management, local Fire Marshall, or Authority Having Jurisdiction (AHJ). Additionally, they must be aware the local jurisdiction may have other safety requirements for fueling procedures at their airport.

a. Airport Operators holding a Part 139 certificate should be aware that it is their duty to provide a briefing to tenant fueling agents on the fire codes in effect at the airport that differ from NFPA 407.

4. Hand Held Fire Extinguishers. Each student must receive hands-on training in the proper use of hand held fire extinguishers. Companies listed in the Addendum must provide this training or highlight the requirement for the student to receive this training from their local fire department or other local qualified source.

a. Certificates of completion for courses that do not include hand held fire extinguisher training must include a statement indicating “excluding hands-on fire extinguisher training”.

b. If hands-on fire extinguisher training is not provided by a company listed in the Addendum, the supervisor is required to complete this training via local fire departments or another qualified provider. A statement or a certificate of completion for hands-on fire extinguisher training must be dated and signed by an approving authority. The statement or certificate of completion must be maintained in the student’s training record as part of the certification that the supervisor has completed all of the required elements of a course in aviation fuel safety in a manner acceptable to the Administrator.

c. Hands-on fire extinguisher training, if not provided concurrently with the supervisory and/or line service training course in fire safety, must be completed within 60 days of completion of the supervisory training course in fire safety.

5. Airport Specific Courses. An individual airport may create and submit for approval a supervisory or line service course in fuel safety that is specific to a particular airport.

a. Such a course may exclude items from section 2 of this chapter that do not apply to that specific airport.

Chapter 3. Supervisors Training Course

The contents of Chapter 2 form the basis of the Supervisory Training Course. This chapter identifies the additional requirements that must be met in the Fire Safety for Supervisors Training Course. In addition, the depth of instruction in each section identified in Chapter 2 must be sufficient to ensure that supervisors understand the material and their responsibilities in training others in fire safety.

1. The FAA recommends that instructors teaching the Supervisor Fuel Training Course possess:

a. A thorough working knowledge of the contents of Chapter 2 and **requirements of 14 CFR §139.321(b)(1) through (b)(7) and §139.321(e) (1) and (2).**

b. A minimum of 2 years' experience in all aspects of fueling procedures.

2. Instructors teaching the Supervisor Fuel Training Course must be able to discuss training methodologies and motivation and understand how to test student comprehension and recognition.

3. Each supervisor must receive training in the proper use of hand held fire extinguishers. Companies listed in the Addendum must provide this training and identify the requirement for the student to receive this training from their local fire department.

a. Certificates of completion for courses that do not include hand held fire extinguisher training must include a statement indicating "excluding fire extinguisher training".

b. If hand held fire extinguisher training is not provided by a company listed on the Addendum, the supervisor is required to complete this training via local fire departments. A statement or a certificate of completion for fire extinguisher training provided by a local fire Department must be dated and signed by an approving authority. The statement or certificate of completion from the local fire authority must be maintained in the student's training record as part of the certification that the supervisor has completed all of the required elements of a course in aviation fuel safety in a manner acceptable to the Administrator.

4. The date of the fire extinguisher training, the date of completion of the fuel safety course, or whichever occurred most recently should be used as the date to verify completion of all required elements of aviation fuel safety training.

Chapter 4. Testing, Certification, and Recordkeeping

1. Exams. Exams or tests may be oral, written, practical, or a combination. All test questions must be researched and referenced with validation of correct answers shown in the master test and retained on file.

2. Record-keeping.

a. Responsibilities of Airport Fueling Agents.

(1) Fueling agents must maintain a copy of the certificate of completion for any supervisors completing a supervisory course in fueling safety for 24 consecutive calendar months.

(2) 14 CFR §139.321(e)(2) requires all employees to receive initial hands-on and recurrent training from a supervisor who has completed a Supervisory Training Program in Fire Safety. Records of that training must be maintained by the fueling agent for 24 consecutive calendar months.

(3) At locations where the training required under §139.321(e)(2) is provided through an approved Line Service Fire Safety Training Program, fueling agents must maintain a copy of the certificate of completion for 24 consecutive calendar months.

b. Responsibilities of Tenant Fueling Agents. Tenant fueling agents must record and retain the certificate/record of completion in the fuel safety supervisor's training record or the line person's training record, as appropriate, by the party certifying course completion for 12 consecutive calendar months. Line service personnel completing an online or offsite course must also have documentation of onsite training conducted by the tenant fueling agent's trained supervisor. Tenant fueling agents must also provide the airport operator/certificate holder a written confirmation once every 12 consecutive calendar months that the training required by 14 CFR §139.321(e) has been accomplished.

3. Certificates. Certificates must differentiate between supervisor training and line service training.

a. Supervisor certificates must have the following wording:

- (1) Name of company doing the training
- (2) Name of individual who completed the "**Fuel Safety Supervisor**" training
- (3) "**Has successfully completed all classroom and practical application for the requirements of 14 CFR §139.321(b)(1) through (b)(6) and §139.321(e) (1)**"
- (4) Date of completion

b. Line training certificates must have the following wording:

- (1) Name of company doing the training
- (2) Name of individual who completed “**Line Fuel Service**” training
- (3) “**Has successfully completed all classroom and practical application for the requirements of 14 CFR Part §139.321(b)(1) through (b)(7) and 139.321 (e) (2)**”
- (4) Date of completion

c. The FAA does not endorse any training programs; however, certificates issued as a result of completion of an approved training program in fire safety may include the following:

- (1) A statement indicating the associated training program is on the FAA’s Addendum of approved training facilities.

Chapter 5. Guidelines for Submitting Line Service and/or Supervisory Safety Course(s)

1. Supervisory Training Program and/or Line Training Program.

a. Purpose. This chapter establishes the standards for submitting a Fueling Safety Training Program for Supervisory Personnel and/or Fueling Safety Training Program for Line Service Personnel. It provides guidance for addressing the requirements of 14 CFR §139.321 (e) (1) and (2) and the additional requirements for supervisory personnel stipulated by §139.321 (b) (1) – (7).

b. Explanation. Fueling Safety Programs are also known as Fueling Supervisory Courses, Line Service Supervisory Training, and Fire Safety Training. These courses ensure that supervisory and line fueling personnel recognize the importance of aircraft fueling safety. Fueling supervisory courses are designed to emphasize the importance of instructing effectively in the principles necessary to ensure safety during fueling operations on airports.

c. Introduction. Fueling safety involves several areas: aircraft fueling, fuel transport, and fuel storage. Failure to follow safe operating procedures during any of these activities on and off the airport can result in accidents. Fueling procedures and practices have been designed to minimize the risks associated with flammable materials for the protection of fuelers themselves, other airport personnel, and the general public. Instruction in this subject is vital and a necessary part of airport safety.

(1) The FAA recommends the training addressed by these guidelines include at least 16 to 18 hours of class time. In addition to classroom training, students must receive appropriate demonstrations and hands-on training. Curriculum development personnel must ensure the minimum content identified in Chapters 2 and 3 of this AC are addressed. Safety must be paramount during training and enforced throughout the entire training course.

2. Supervisors Fuel Training Curriculum. This curriculum must address the contents of Chapter 2, including material marked “Supervisory Requirement”. An outline of the course, testing material, references, and a sample of the course completion certificate must be submitted to the FAA for review.

3. Line Service Fuel Safety Training Curriculum. The curriculum must address the contents of Chapter 2. An outline of the course, testing material, references, and a sample of the course completion certificate must be submitted to the FAA for review.

4. Review and Approval.

- a.** All courses should be submitted for initial approval and also whenever there any major rewrites or changes to the material being taught.

- b.** Send curriculum materials to:

Federal Aviation Administration
Manager, Airport Safety and Operations
Attn: Fuel Safety Training
800 Independence Ave SW
AAS-300, Room 618
Washington DC 20591

The FAA will add acceptable courses to the Addendum of Authorized Fuel Safety Training Courses on a quarterly basis.

Appendix A. Definitions and Acronyms

DEFINITIONS

Airport Fueling Agent - An airport operator/certificate holder that sells fuel products on the airport.

Airport Fueling System - An arrangement of aviation fuel storage tanks, pumps, piping, and associated equipment, such as filters, water separators, hydrants and station, or aircraft fuel servicing vehicles, installed at an airport and designed to service aircraft at fixed positions.

Authority Having Jurisdiction (AHJ) - An organization, office, or individual responsible for enforcing the requirements of a code or standard or for approving equipment, materials, an installation, or a procedure.

Dead Man Control - A device that requires a positive continuing action of a person to allow the flow of fuel.

Emergency Fuel Shutoff - A function performed to stop the flow of fuel in an emergency.

Fueling Agent - A person or company that sells fuel products on the airport. This is intended to exclude the self-fueling activities of an airline or corporation that conducts self-fueling.

Self-Fueling and Self-Service - Self-fueling means the fueling or servicing of an aircraft by the owner of the aircraft with his or her own employees and using his or her own equipment. Self-fueling cannot be contracted out to another party. Self-fueling implies using fuel obtained by the aircraft owner from the source of his/her preference. Self-fueling differs from using a self-service fueling pump made available by the airport, a Fixed Base Operator (FBO), or an aeronautical service provider. The use of a self-service fueling pump is a commercial activity and is not considered self-fueling as defined herein. Self-service includes activities such as adjusting, repairing, cleaning, and otherwise providing service to an aircraft, provided the service is performed by the aircraft owner or his/her employees with resources supplied by the aircraft owner. Title 14 CFR Part 43 of the Federal Aviation Regulations permits the holder of a pilot certificate to perform specific types of preventative maintenance on any aircraft owned or operated by the pilot.

NOTE: Fueling from a pull-up commercial fuel pump is not considered self-fueling under the Federal grant assurances since it involves fueling from a self-service pump made available by the airport or a commercial aeronautical service provider.

Tenant Fueling Agent - A person or company that sells fuel products on the airport, other than the certificate holder.

ACRONYMS

AC	Advisory Circular
AHJ	Authority Having Jurisdiction
CFR	Code of Federal Regulations
DOT	Department of Transportation
FAA	Federal Aviation Administration
FBO	Fixed Base Operator
NFPA	National Fire Protection Association
PPE	Personal Protective Equipment

Appendix B. Additional Resources

1. **ATA Spec 103** – Spec. 103, *Standard for Jet Fuel Quality Control at Airports*, produced by Airlines for America, provides guidance for the safe storage and distribution of jet fuel at airports as currently practiced in the commercial aviation industry. Spec. 103 can be obtained from:

A4A Publications Department
1301 Pennsylvania Avenue, NW
Suite 1100
Washington, DC 20004
202-626-4062
<https://publications.airlines.org>

2. **NATA Refueling and Quality Control Procedures for Airport Service and Support Operations** – The National Air Transportation Association's (NATA's) refueling and quality control guidebook provides information and detailed procedures on the safe handling and delivery of aviation fuels. The guide is available from:

National Air Transportation Association
4226 King Street
Alexandria, VA 22302
800-808-6282
<http://www.nata.aero>

3. **ASTM Manual 5, Aviation Fuel Quality Control Procedures** – Manual 5 provides a complete explanation of several common procedures used by fuel handlers to assess and protect aviation fuel quality. Manual 5 can be obtained by contacting:

ASTM Customer Service
610-832-9585
610-832-9555 Fax
service@astm.org
<http://www.astm.org>

Addendum of Authorized Fuel Safety Training Courses

The current Addendum, updated quarterly, is available online with this AC at http://www.faa.gov/regulations_policies/advisory_circulars/.