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Federal Aviation Agency

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ADVISORY CIRCULAR

Superseded by AC 20-29A on 6/19/67

SUBJECT: USE OF PHILLIPS PETROLEUM COMPANY'S ADDITIVE PFA-55MB AS AN ANTI-ICING AGENT

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1. PURPOSE. This circular provides information on the use of Phillips additive PFA-55MB as an acceptable means of compliance with the Civil Air Regulations that require assurance of continuous fuel flow under conditions where ice may occur in turbine aircraft fuel systems.

2. REFERENCE REGULATIONS. Part 4b, section 4b.435(d), of the Civil Air Regulations.

3. BACKGROUND.

   a. FAA - The Southern Region approved the use of a 0.10 percent concentration (by volume) of PFA-55MB in all turbine aircraft fuels in December 1962. This approval was based upon compatibility tests of the additive in certificated aircraft and engines at a concentration of 0.15 percent of the fuel by volume and did not include approval for the use of the additive in lieu of fuel heaters. FAA may approve the 0.15 percent concentration where compatibility with the aircraft and engine fuel systems has been demonstrated (see Advisory Circular AC 20-24).

   b. Air Force - The United States Air Force, after extensive tests with PFA-55MB in JP-4 fuel, concluded that the additive satisfactorily prevents the formation of ice in the fuel. Since April 1, 1962, this additive, under its Military Specification No. Mil-I-27686A, has been used in all JP-4 fuel produced in the United States. At the present time, with the exception of a few areas, the use of the additive in JP-4 fuel is worldwide.

4. USE OF ADDITIVE IN KEROSENE. The characteristics of PFA-55MB in kerosene type fuel are similar to those in JP-4 fuel. Commercial aircraft kerosene, however, does not contain the additive and provisions for blending it into this type of fuel present a complication to its use. The additive is readily soluble in water but its solubility in the fuel is relatively low. It is, therefore,

essential that the additive be uniformly blended into the fuel with proper equipment and procedures. Blending facilities and the additive are available at some airports, but cases will arise where it will be necessary to blend at the aircraft to assure icing protection. To provide for these cases, it may be necessary for the aircraft to carry both the additive and blending equipment.

5. WATER IN FUEL.

a. Presence of Water in Fuel - Although rigorous precautions are taken to ensure that fuel being pumped into an aircraft contains as little water as possible, an aircraft fuel containing no water is an impossibility. This is due primarily to the affinity that hydrocarbon fuels have for water. Even if fuels are prepared, handled, and used without even contacting liquid water, the fuels will contain water picked up from the air. The extent of such pickup is largely a function of the humidity of the air drawn into the fuel tank to equalize the pressure resulting from changes in tank temperature and pressure.

b. Affinity of Fuel for Water - The affinity that fuel has for water varies with its composition and temperature. The saturation level for a jet fuel in parts per million by volume is approximately equivalent to the temperature in degree F.; that is, a jet fuel at 50° F. may contain approximately 50 parts per million of dissolved water. When the fuel is cooled, that water which is above the saturation level is rejected as discrete water in minute particles. Until this water can coalesce and migrate to the bottom of the tank it will be carried in the fuel. At temperatures below the freezing point, these minute particles may be supercooled and will be deposited out only when they strike a solid obstruction and freeze.

c. Effect of Gravity - The small differences in the specific gravity of water and jet fuel (1.0, 0.77, and 0.83, respectively, for water, JP-4 and kerosene) complicate the task of removing the discrete water dispersed in the fuel. While this water will in time settle out of the fuel, the particle size is so small that filters and water separators cannot be depended upon for its complete removal. Experience has shown that jet fuels may contain up to 70 parts per million of dispersed water.

d. Condensation of Water in Flight - An aircraft after a long flight at high altitudes will have tank surfaces and fuel that are colder than the air that is drawn into the tank during descent. When moisture-laden air enters the tank space, condensation may occur

in the tank. Due to the higher viscosity of cold fuel, this water will not settle out as readily and will be carried as dispersed water for a longer period of time. Under these conditions, the dispersed water in the fuel may reach 100 parts per million.

e. Microbia Control - Fuel tank corrosion has been a problem in jet aircraft due to the presence and growth of microbia at the water and fuel interface. Elimination of water and contaminants from the fuel and water reduces this corrosion, but complete elimination of the water is not possible. Experience with fuel containing PFA-55MB has shown that when the concentration in the fuel is maintained above .05 percent by volume it is effective in eliminating many types of microbia growth and thus reduces tank corrosion.

6. ADDITIVE CONCENTRATION. Data submitted by the Phillips Petroleum Company indicate that a .015 percent by volume concentration of PFA-55MB additive would prevent ice formation in fuel containing 100 parts of water per million down to a fuel temperature of -40° F. Additive concentrations exceeding .015 percent by volume are necessary, however, for the following reasons:

a. The additive tends to separate out of the fuel during its transportation (often via long pipe lines) from refinery to aircraft, and during long-time storage in refueling tanks. A drop in additive concentration to one-third the original refinery value has been reported.

b. Free water may have accumulated in the aircraft tank in sufficient quantity to leach further additive from the fuel.

c. Techniques for measuring the additive concentration of fuels necessarily involve some accuracy tolerance.

The Agency therefore considers that, to ensure continuous fuel flow under conditions where ice may occur in the fuel system, the minimum additive concentration for a loaded aircraft tank should be .035 percent by volume. Moreover, to ensure that this concentration is maintained in the loaded aircraft tank, it should be refueled with fuel containing an additive concentration of at least .06 percent by volume.

7. ACCEPTABLE MEANS OF COMPLIANCE. Fuel containing Phillips Petroleum PFA-55MB anti-icing additive may be approved as an acceptable means of complying with § 4b.435(d), if such fuel has been demonstrated to be compatible with the engine and aircraft fuel systems at an additive concentration of 0.15 percent by volume **using the procedures set forth in Advisory Circular AC 20-24. Requests for such approval are considered by the Chief, Engineering and Manufacturing Branch, for the region in which the applicant is located. The approval, in each case, is subject to the following conditions:**

a. Placarding - The aircraft should be placarded near the fuel filler cover to show that fuel to be used must contain PFA-55MB additive within the minimum and maximum allowed concentration.

b. Manuals - Federal Aviation Agency approved flight manuals should contain the following:

(1) The minimum concentration of the additive in a loaded fuel tank should be at least .035 percent by volume.

(2) The minimum concentration of the additive in the fuel with which the aircraft is to be refueled should be at least .06 percent by volume.

(3) The maximum concentration of the additive that may be used in fuel is 0.15 percent by volume.

(4) The procedures that are to be used in blending the additive into the fuel.

(5) A list of approved types of equipment that may be used for blending the additive into the fuel.

(6) The procedures and approved equipment that may be used to determine the concentration of the additive in the fuel.

(7) A list of trade names under which the additive may be obtained.

(8) The minimum equipment that is required and approved for operations.

c. Tests - The applicant should show by tests that his additive sampling and blending procedures are feasible.

for George S. Moore
Director
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