Accident Prevention Program

ALL ABOUT FUEL

This pamphlet provides information about aviation fuels and the safety precautions that need to be observed during aircraft fueling.

The introduction of turbine-powered aircraft into the civil aircraft fleet during the 1950's caused many changes in the marketing of aircraft fuels. As the air carrier and military fleets were converted to turbine-powered aircraft, the demand for aviation gasoline (avgas) decreased drastically. Aviation fuels now represent a relatively small portion of the petroleum industries by products and therefore the produKion of avgas in multigrades is no longer economically feasible. During the past few years, we have seen 91/96, and 115/145 octane fuels disappear from the market. In 1971 the oil companies began development of a single grade avgas that would meet the needs of all reciprocating powered aircraft.

80/87 vs 100LL

When the 80/87 began to disappear from the avgas market and 100LL was introduced to take its place, operators expressed concern about the service life expectancy of their low compression engines. Some operators experienced accelerated exhaust valve erosion and valve guide wear from the use of highly leaded 100/130 (green) avgas in their engines that were rated to use a minimum grade 80 octane fuel. The engine manufacturers were quick to provide aircraft owners with amended operating procedures and maintenance schedules which helped minimize the engine malfunctions resulting from the use of high lead 100/130 avgas. Experience of the past ten years has proven that low compression aircraft engines can be operated safely on 100 low lead avgas without difficulty, providing they are operated and serviced in accordance with the approved aircraft owners manual or other officially approved document.

AUTOMOTIVE GASOLINE

Leaded automotive gasoline is not recommended as a substitute for aviation gasoline because of the differences in properties and composition of the two types of fuel. Regular leaded automotive gasoline may cause preignition and detonation, vapor lock, and sticking or burned valves when used in aircraft engines. Lead-free automotive gasoline, however, has been extensively tested in aircraft equipped with low compression engines that use low octane fuel by the Experimental Aircraft Association and other Organizations. The Federal Aviation Administration has issued supplemental type certificates (STC) to these organizations permitting the use of unleaded automotive gasoline of 87 minimum antiknock index per ASTM specification D-439. Each make/model aircraft shall be modified and operated in accordance with the instructions, limitations, and procedures contained in the STC when unleaded automotive gasoline is used.

PLACARDS-TYPE OF FUEL

Be sure you get the type of fuel that is specified. Federal regulations require that all aircraft filler openings must be marked with the word 'fuel' and the minimum fuel grade for reciprocating powered aircraft, or the permissible fuel designation for turbine-powered aircraft. Even these requirements do not rule out the possibility of being serviced with the wrong type of fuel. Pilots should be particularly cautious when being serviced at facilities that provide turbine fuel as well as avgas. Turbine or jet fuel is detrimental to the reciprocating engine and extended use of avgas can damage turbine engines. Therefore, it is imperative for flight crews to double check when their aircraft is serviced to assure that they receive the proper type and grade of fuel. Although this responsibility is placed upon the pilot by regulation it just makes good sense to be sure. The fuel system sumps should always be drained and checked for contaminants after each fueling of the aircraft and during preflight inspection.

FUEL ADDITIVES

The FAA and several engine manufacturers have approved the use of certain carburetor anti-icing fuel additives in aviation gasoline. However, such additives should not be used without consulting the airframe manufacturer because their chemical content may not be compatible with the aircraft fuel system cells, seals, etc.

The same is true with lead scavenging additives such as Tricresyl Phosphate (TCP). TCP, for example, has been used successfully to reduce lead fouling of spark plugs in normally aspirated reciprocating engines for several years. However, TCP should not be used in turbocharged or supercharged engines without approval of the airframe manufacturer. TCP must be mixed according to the instructions provided by the manufacturer, Alcor Inc., for maximum effectiveness.

SPARK PLUG FOULING AND HOW TO AVOID IT

In most cases spark plug fouling can be reduced or eliminated by simply applying proven operating techniques. For example, low operating temperatures coupled with rich fuel mixtures result in incomplete vaporization of the tetraethyl lead in the combustion chamber causing lead fouling of the spark plugs. Maintaining proper cylinder head temperatures will minimize plug fouling problems. Be certain that maintenance personnel have installed the spark plugs recommended for the particular engine installation. Have the carburetor idle mixture checked and adjusted. Use recommended leaning techniques in cruise condition at all altitudes. Avoid low power letdowns, descend with power, and avoid over rich conditions. Carburetors and fuel injectors are normally set slightly rich in the closed throttle position, so it is best to carry a slight amount of power on landing approaches rather than approach with closed throttle. Keep the cylinder temperatures in the normal range during operation. After flight or ground operations, before shutdown, advance the throttle to about 1800 RPM for 15 to 20 seconds to clear the plugs and combustion chambers, retard the throttle to about 1200 RPM and shut the engine off immediately with the mixture control. You should not have plug fouling or misfiring on

your next startup. As long as you make sure the aircraft is serviced with the proper fuel, check the sumps for contaminants, operate the engine according to the aircraft owners manual and have the spark plugs serviced as recommended, you should not have plug fouling problems.

TURBINE FUEL

Occasionally, aircraft are inadvertently serviced with the wrong type of fuel and in most instances it is because of misleading signs. For example, certain turbo-supercharged reciprocating powered aircraft have paint designs with the word TURBO conspicuously displayed on the vertical stabilizer or on the engine nacelle. Line service personnel assumed this to mean turbojet and filled the tanks with jet fuel. Another incident involved an air carrier type aircraft that was originally equipped with reciprocating engines which most operators converted to turbo-props. The service personnel assumed the aircraft was a converted model when it wasn't.

Reciprocating engines may run briefly on jet fuel, but detonation and overheating will soon cause power failure. So, beware of getting jet fuel when you need avgas. Avgas is no substitute for jet fuel either. The engine failure caused by running the turbine engine on the wrong fuel may not be as sudden, but prolonged operation on gasoline will severely damage the engine by the lead content and differiny combustion ranges of the fuel. Time limitations for use of avgas in turbine engines are listed in the airplane or rotorcraft flight manual.

PRE-FLIGHT ACTION

The responsibility is yours, the pilot, to determine that your aircraft is properly serviced. Check your aircraft before each flight and be sure yu have the correct type of fuel. It may save your life. Take the time to inspect your aircraft thoroughly. (1) Be sure all of the fuel and oil tank caps and covers are installed and secured properly after you visually check the fluid level. Observe the color and odor of the fuel as you check the tank. (2) Draw a generous sample of fuel from each sump and screen drain into a transparent container. Check for the presence of water, dirt, rust or other contaminants. Don't be so frugal as to save the fuel drained from the sumps by pouring it back into the tank. There are people who do. Don't risk the possibility of contaminating the system, get rid of it. (3) Check that each fuel tank vent is clear of restrictions; i.e., dirt, ice, snow, bent or pinched tubes, etc.

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