



U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Subject: USE OF ALTERNATE GRADES
OF AVIATION GASOLINE FOR
GRADE 80/87, AND USE OF
AUTOMOTIVE GASOLINE

Date: 7/18/84

AC No. 91-33A

Initiated by: ANE-110

Change:

1. **PURPOSE.** This circular provides information relating to the use of alternate grades of gasoline when Grade 80/87 aviation gasoline is not available and to the resultant effects of the use of alternate fuels which have higher TEL (tetraethyl lead) content. Suggestions are offered as acceptable means of avoiding engine operating difficulties when using alternate fuels. This Circular also provides suggestions for added safety in the use of automotive gasoline in those aircraft engines and aircraft covered by Supplemental Type Certificates (STCs).
2. **CANCELLATION.** AC 91-33, effective October 6, 1971, is cancelled.
3. **REFERENCE.** Part 33, Section 33.7
4. **BACKGROUND.** Aviation gasoline demand has decreased steadily to a relatively insignificant portion of the total oil market. Escalating production costs and other factors have caused the oil industry to improve its economics by providing a single grade of aviation gasoline, Grade 100 low lead (100LL), which would be suitable for most current and projected piston aircraft engines. As a result, Grade 80 aviation gasoline has become increasingly difficult to obtain and this situation is expected to become more critical in the near future. The shortage, and perhaps eventual disappearance, of Grade 80 aviation gasoline affects those reciprocating engines which were originally certificated on 80/87 octane or lower grade fuel. Owners or operators of aircraft incorporating these engines may be forced to use Grade 100LL, Grade 100 aviation gasoline or, in the cases where STCs are obtained, automotive gasoline. The basic difference between Grade 80 aviation gasoline and the two grades of 100 octane fuel is tetraethyl lead (TEL) content. Grade 80 (red) gasoline contains a maximum of 0.5 ml/gal of TEL, whereas Grade 100LL (blue) gasoline may contain up to 2 ml/gal TEL and Grade 100

(green) gasoline up to 4.0 ml/gal TEL. It is this increase in lead content which can produce problems in these older aircraft piston engines. As long as Grade 80 gasoline was generally available, higher grade fuels were only used occasionally. This occasional use of higher grade fuels rarely, if ever, caused any problems. When Grade 80 fuel became scarce, many engines had to use higher grade fuels exclusively and problems in the form of increased maintenance began to be reported. Since 1982, STCs have been issued for the use of specified automotive gasolines in certain aircraft engines and aircraft and provide an additional source of fuel for several piston engine models that were originally rated for Grade 80 or lower octane aviation gasoline. The STCs were issued after each different airplane and engine combination was evaluated to assure compliance with applicable FARs and that the airplane was safe for continued operation on automotive gasoline. Owners and operators are cautioned that only airplanes that have been modified in accordance with the STC are eligible to be operated on automotive gasoline.

5. FUELS GRADES.

a. **MINIMUM GRADES.** The fuel specified in the FAA type certificate data sheet or STC, which defines the approved limits for operation, is the minimum grade fuel that should be used. It would be unsafe to use fuel of lower grade because destructive detonation and possible subsequent preignition could occur, and it would be contrary to the operation limitations to operate on a lower grade fuel.

b. **HIGHER GRADE.** When using a higher grade fuel than that specified as a minimum grade, the engine manufacturer's instructions should be observed.

6. **AVIATION GASOLINES.** The shortage of Grade 80 aviation gasoline in the early 1970's forced the use of higher leaded aviation fuels in many engines which were rated for Grade 80/87 fuel. This relatively sudden forced use of higher leaded fuel brought about a rash of problems associated with increased maintenance because of lead fouling. Since that time procedures have been made available to reduce the problems associated with the use of higher leaded fuels. As long as recommended maintenance practices are followed, there are no safety problems resulting from using higher leaded aviation gasoline in engines certified for Grade 80 fuel. Major engine manufacturers have issued Service Bulletins, Instructions, and/or Letters which provide information and operating procedures to minimize the additional maintenance associated with the use of higher leaded fuels. Pilots should obtain and study this information prior to

operation of engines rated on Grade 80/87 fuel with Grade 100LL or Grade 100 aviation gasolines.

7. AUTOMOTIVE GASOLINES. The FAA does not regulate the distribution systems for either aviation gasoline or automotive gasoline. Nor does it regulate the specifications for either fuel. It does, however, approve the use of fuel to a given specification in an aircraft engine. The distribution, control, and quality of these fuels are maintained and self-policed by industry. Traditionally, industry has claimed to maintain strict control over the distribution for aviation gasoline and has established checks at specific points in the system to ensure product quality. This type of control is not applied to all automotive gasolines. When automotive gasoline was approved for use in certain aircraft piston engines, the FAA specified only the use of certain gasolines that meet American Society for Testing Materials (ASTM) Specification No. D-439. However, it should be noted that not all automotive gasolines being marketed meet specification D-439 requirements. In addition, there are composition differences between aviation and automotive gasolines which should be recognized when using automotive gasolines in those aircraft engines and aircraft for which STCs have been obtained. Therefore, the following observations are offered:

- a. Automotive gasoline for aviation use should be purchased from fuel vendors who are known for their integrity in offering quality products. It is generally preferable to obtain this fuel from airport operators or airport vendors that offer this product because such sources are likely to obtain it from reliable fuel distributors and to maintain typical aviation fuel cleanliness. Appropriate fuel filtering should be done prior to or during refueling whenever fuel cleanliness may be suspect for any reason. The users should familiarize themselves with local ordinances or policy regarding individuals bringing onto or storage of their own fuel on any particular airport.
- b. Long-term fuel storage of automotive gasoline in aircraft fuel tanks should be avoided. Although automotive gasolines have lower maximum existent gum specification requirements than aviation gasoline, either fuel can form undesirable gum deposits over long-term storage under particularly severe conditions, such as in barrels and at high temperature. Gum deposits thus formed could result in engine malfunctions.
- c. FAA Technical Center testing indicates that carburetor icing will occur in less time and at higher ambient temperatures with automotive gasoline than with aviation gasoline.

Therefore, pilots using automotive gasoline should be familiar with the induction system icing prevention procedures of the FAA Advisory Circular AC 20-113 and be prepared to use these procedures at higher ambient temperatures and lower humidities than when using aviation gasolines.

- d. After any prolonged period of heat-soak (e.g., aircraft sitting in sun or hot ground idling) it is recommended that the availability of full power be established before commencing a take-off.
- e. FAA approvals for use of automotive gasoline have not included any gasoline which is blended with alcohol. Gasohol, regardless of whether it meets ASTM D-439, is not considered automotive gasoline for purposes of FAA approvals.

8. **GASOLINE TURBINE FUEL.** Where 80/87 aviation gasoline is certificated for use in turbine engines, the substantiation of a gasoline with a greater amount of lead must have the approval of the turbine engine manufacturer. The additional lead and other additives will cause premature deterioration of the hot parts if its use is not restricted sufficiently.

9. **OBSOLETE GRADES.** Some engine specifications might still call for fuel grades that are now obsolete. In the case of the obsolete Grade 91/96 the TEL content of this fuel has always been more than that of Grade 80/87 fuel; therefore, when substituting a higher lead fuel, the problems will be of the same nature, but of a lesser degree than that experienced when Grade 100LL was substituted for Grade 80/87. For engines specifying obsolete grades lower than Grade 80/87, the manufacturer's recommendations should permit safe operation.

/s/ Robert E. Whittington