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# Advisory Circular

**Subject:** APPROVAL OF AUTOMOBILE GASOLINE  
(AUTOGAS) IN LIEU OF AVIATION  
GASOLINE (AVGAS) IN SMALL AIR-  
PLANES WITH RECIPROCATING ENGINES

**Date:** January 25, 1985 **AC No:** 23.1521-1  
**Initiated by:** ACE-100 **Change:**

1. PURPOSE. This Advisory Circular (AC) provides information and guidance concerning an acceptable means, but not the only means, of compliance with Part 3 of the Civil Air Regulations (CAR) and Part 23 of the Federal Aviation Regulations (FAR), applicable to approval procedures covering use of autogas in small airplanes. These procedures will also apply to those airplanes approved under Part 4a of the CAR. Accordingly, this material is neither mandatory nor regulatory in nature and does not constitute a regulation.

2. RELATED FAR SECTIONS. For convenience, the related sections of CAR, Part 3 reference, corresponding to the sections of FAR, Part 23, are shown in parentheses.

- a. Section 23.1521(d) (3.744(c)).
- b. Section 23.961 (3.438).
- c. Section 23.955 (3.429).

3. BACKGROUND.

a. Section 23.1521(d) (3.744(c)) requires the minimum fuel grade be established so that it is not less than that required for the operation of the engine. The Type Certificate Data Sheet (TCDS) for the engine specifies the minimum grade aviation gasoline that has been established during type certification of the engine. Aviation Grades 80/87, 100/130, and 100LL fuels are common grade gasolines approved for airplane engines.

b. In recent years, some petroleum manufacturers have discontinued the production of Grade 80/87 aviation fuel. Therefore, several alternate fuels have been proposed for normally aspirated or supercharged, fuel-injected, or carbureted low-compression engines that were approved for operation on Grade 80/87 octane fuel.

c. Autogas is one possible alternate fuel. Currently, gasolines are manufactured to at least two different specifications available from the American Society for Testing and Materials (ASTM). These specifications are ASTM D 910 for avgas and D 439 for autogas.

d. Several Supplemental Type Certificates (STCs) have been issued to allow use of unleaded and leaded avgas in small airplanes. It is necessary to evaluate each engine and airplane model for compliance with the applicable FARs and determine that it is safe for continued operation. Therefore, an STC is required for each different series or sub-series of engine and airplane models, for which approval is requested. An STC is issued to an applicant who demonstrates to the FAA that the modification meets the applicable regulations. The STC does not automatically apply to other airplanes. The STC data developed by the applicant including drawings, reports, etc., are proprietary. An STC should be obtained from the owner and the modification should be defined by the technical data incorporated on the airplane or the applicant can develop his own data and obtain an STC approval from the FAA.

#### 4. ACCEPTABLE MEANS OF COMPLIANCE.

a. It is essential that the airplane engine be approved for operation on avgas before avgas is eligible for approval in the airplane. Engines that are approved for operation on 80/87 grade aviation fuel, or which have a compression ratio of approximately 7.2:1 or less, should operate satisfactorily on avgas. Engines having a compression ratio greater than 7.2:1 may experience detonation with associated engine destruction when operating on low-octane avgas. In either case, operation of the engine with any alternate fuel must be shown to meet the minimum design requirements for the engine and be approved. Testing of the engine and airplane may be conducted concurrently. Advisory Circular 20-24A describes an acceptable method of obtaining approval for the engine to operate on avgas. Advisory Circular 91-33 contains information on use of alternate grades of avgas in airplanes.

b. Evaluation of an application for STC of an airplane for operation on avgas should consider the following items:

(1) A hot weather operation test per section 23.961 should be conducted. The airplane should be tested to the maximum altitude for which approval is requested with the critical fuel. The critical fuel is considered one having a volatility Class E or winter grade from a northern geographical class of the United States with an antiknock designation of 2 or 87 index. Refer to ASTM D 439 for location and seasonal variations of avgas. This fuel should be available on the open market for those regions of the United States. The test fuel should be analyzed for compliance with the limits of the ASTM D 439.

(2) Engine cooling tests per section 23.1041 have not been found to be critical; however, those tests should be evaluated for compliance with the regulations.

(3) Evaluate for normal engine operation during all approved aircraft maneuvers; e.g., takeoff and landing, balked landing, stall, spins, etc. Also engine operation when changing from one tank to another, per section 23.955(e), should be evaluated.

(4) Carburetor heat rise test per section 23.1093 has not been found to be critical; however, carburetor heat rise must be evaluated for compliance with regulations.

(5) Suction lift fuel systems are more critical than pressure feed systems with respect to vapor formation and should be evaluated for operational problems.

(6) Evaluate the engine for proper operation and that engine rated horsepower is within the limitations specified on the applicable Airplane Type Certificate Data Sheet. Airplanes with fixed pitch propellers can be evaluated by determining the static r.p.m. and manifold pressure are within TCDS limits. If engine power is degraded with use of autogas, evaluation of these effects on airplane performance is necessary.

(7) Establish compatibility of fuel system material (elastomers, sealants, seals, liners, hoses, etc.) with autogas.

(8) Establish compatibility of fuel quantity gauging system with autogas.

(9) Preparation of a Supplemental Airplane Flight Manual or Airplane Flight Manual Supplement, as applicable, is necessary to specify the airplane's proper operating procedures and limitations. A Supplemental Airplane Flight Manual may be necessary for airplanes that do not have Airplane Flight Manuals. Procedures for determining that the fuel is free of contamination, does not contain unapproved materials such as alcohol and meets the minimum specification for which approval was requested, should be included in the Airplane Flight Manual. Advisory Circular 20-43 contains advisory material concerning fuel handling procedures and methods to prevent contamination. Procedures for mixing autogas and avgas should be addressed.

(10) Specify appropriate placards to define the approved grade of fuels and any operating limitations. The appropriate fuel specification such as ASTM D 439 should be included.



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