Transport Canada Transports Canada

TP 10737E

THE USE OF AUTOMOBILE GASOLINE

(MOGAS)

IN AVIATION

TRANSPORT CANADA

AMENDMENT 2, March 31, 1993

Canada

FOREWORD

TP 10737, "Use of Automotive Gasoline (Mogas) in Aviation", is published by Transport Canada under the authority of the Director General, Aviation Regulation by the Director, Airworthiness.

This document has been prepared for the use and guidance of owners and operators of light piston powered aircraft originally approved for the use of Avgas 80/87 and in some cases 100/130 aviation fuel, for the purpose of substituting unleaded automotive gasoline as an alternate fuel.

The MOGAS manual will be maintained as a dynamic document that will be amended based upon the field experience of owners and operators using Mogas as an alternative fuel.

The Office of Primary Interest is Airworthiness Engineering, Powerplants.

D. Spruston
Director General
Aviation Regulation

LOG OF AMENDMENTS PAGE

AMEND. NO.	DATE	PAGES AFFECTED	SUBJECT	APPROVED:
1	91 Dec. 15	17 18-25 5 10 10	Listing of Canadian Manufactured Antique aircraft (Appendix C) Listing of STCs available (Appendix D) Reformat Table 3 Clarification of Section 4.7 General typographical correction Addition of paragraph 4.9	
2	93 Mar 31	ALL	Restructured entire document. Removal of flight envelope on STC'd aircraft on Canadian Mogas. Allowance of all unleaded fuel grades. Operational aspects expanded.	

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"USE OF AUTOMOTIVE GASOLINE (MOGAS) IN AVIATION"

1.0 INTRODUCTION- GENERAL

This document defines Transport Canada's policy on the use of Automotive Gasoline (MOGAS) in Canadian-registered aircraft. Transport Canada considers Mogas an acceptable fuel for use in specific categories of aircraft as defined in this document and subject to the imposed limitations, requirements and recommendations for the use of Mogas outlined herein.

For the purpose of this document, Aviation Mogas is defined as any grade of unleaded automotive gasoline subject to the requirements of Section 1.1 and Section 5.2 of this document with a minimum anti-knock index of 87, meeting the National Standard of Canada for Automotive Unleaded Gasoline, CAN/CGSB-3.5-92 (or more current issue), or U.S. specification ASTM D4814. Gasoline containing alcohol other than trace amounts used for fuel system de-icing is not permitted.

The types of certified aircraft which may consider using Mogas are those with engines certified to use 80/87 grade aviation fuel, with a compression ratio of 7.65 or less. In addition, high compression ratio, 100 or 100LL certified engines may be eligible to use Mogas after specific modifications. Specific Aircraft eligibility, acceptance procedures, and limitations are given in Sections 7 and 8.

1.1 MOGAS - Important Considerations Prior to Use

Several points must be emphasized when considering the use of Mogas in a General Aviation aircraft:

- The use of Mogas is generally NOT supported by engine manufacturers (in most cases warranties are voided) or by petroleum companies.
- Mogas is not engineered for this purpose. Although Mogas may be considered a suitable alternative to Avgas in some applications, differences in its properties such as its high and seasonally variable volatility necessitates special awareness to assure its safe use. Refer to Section 3 for more details.
- When choosing to fuel with Mogas, a pilot assumes the responsibility of ensuring the suitable quality, seasonal class, cleanliness and grade of fuel purchased. The use of a 5 micron (or finer) aviation type fuel filter with a go-no/go water separator is strongly recommended for any Mogas fuelling operation.
- Petroleum companies producing Mogas will not be held responsible for the appropriateness of the Mogas sold to the consumer for the purpose of fuelling aircraft engines. The pilot himself assumes all responsibility for choosing an appropriate fuel for powering his/her aircraft.
- Her Majesty the Queen, as represented by the Minister of Transport, assumes no liability or responsibility for infringement of any manufacturer's warranty (engine, aircraft or other), accelerated deterioration of the engine, airframe or any components thereof, or any other damage or defects caused or in any way attributable, directly or indirectly, to the use of automotive gasoline (mogas) in aircraft engines.
- Before flying with Mogas, in the interest of your own safety, read this entire document, paying particular attention to section 3, "Operational Considerations".

2.0 BACKGROUND

2.1 Reasons for MOGAS Use in Aviation

With the elimination of 100/130 and the scarcity of 80/87 Avgas, 100LL Avgas and Mogas have become the only two practical fuel alternatives for General Aviation. Engine manufacturers and fuel refiners all recommend 100LL as a viable alternative provided special procedures are followed. Relative to 100LL, however, the name "low lead" means lower lead than 100/130, but lead content of 100LL is FOUR TIMES that of 80/87. Due to this increased lead content, many aircraft owners and operators have found that 100LL can cause reduced maintenance intervals and physical damage to their engines (refer to Section 4 for more details), despite the maintenance and operational procedures recommended by the engine manufacturers and the fuel refiners. The development of a new non-leaded Avgas is underway which is expected to be 98 octane and should thus provide a suitable replacement for 100LL in many aircraft applications.

2.2 U.S. Policy

The U.S. FAA approach to Mogas use has been the approval of Supplementary Type Certificates (STC's) for specific groups of engine/airframe combinations and for specific engines. There are more than 100 STC's for Mogas currently available. These documents require the use of "U.S. Mogas" ASTM-D439 fuel (superceded by ASTM-D4814). Occasionally fuel system modifications are required, and in the case of high compression ratio engines, Anti-Detonant Injection (ADI) systems may be required (for more information on ADI see Section 7.3). In addition, the FAA has accepted the use of Mogas without an STC in "Antique" aircraft, defined as having been certified on or before July 10, 1929.

2.3 Change in Canadian Policy

Prior to this revision, Transport Canada Mogas policy was to accept U.S. Mogas STC's without restriction providing the fuel was shown to meet the ASTM-D439 or D4814 specification. Due to perceived differences in fuel volatility between Canadian and U.S. fuels, if Canadian Mogas was used, a flight envelope of 6000 ft alt. and 24 degrees celcius outside air temperature (OAT) was imposed. Flight beyond this envelope involved further approval via the performance of "envelope expansion" procedures.

The flight envelope restriction of 6000 ft. Altitude and 24 degrees Celcius (OAT) on Canadian Mogas use for Category 1 (antique) and Category 2 (FAA STC available) aircraft is now eliminated (see Section 7 for Category definitions). The envelope existed due to concerns that Canadian Mogas could be significantly more volatile than U.S. fuels and thus an engine/fuel system using it would be considerably more prone to vapour lock and carburettor icing. There is no evidence that Canadian Mogas is in practice significantly more volatile than U.S. Mogas. Volatility limits for U.S. fuels in climatically similar regions to Canada are the same as the Canadian limits, and fuel sample survey results do not indicate a large difference in volatility. There is evidence to suggest that Canadian Mogas is, in fact, more consistent in terms of volatility than its U.S. counterpart. It has therefore been decided to remove the envelope restriction and instead put emphasis on the means of dealing with operational problems such as carb icing and vapour lock (see Section 3). The objective is to replace this operational limitation with useful guidance information that aims to educate pilots to effectively deal with operational problems that already exist with Avgas.

The restriction to "regular unleaded only" is now eliminated. Additives such as MTBE (described in Section 3.1.2), thought to only exist in the premium grade, are now allowed in all grades according to the Canadian standard. Transport Canada will allow the use of fuels containing MTBE. Transport Canada recommends increased scrutiny of fuel system elastomers to detect any potentially increased deterioration due to any fuel component. These recommendations are outlined in Section 3.

If changes in Canadian automotive fuel standards are made in the future that may affect the acceptability of Canadian Mogas as an aviation fuel, this publication will be revised to reflect any changes in Transport Canada policy.

3.0 OPERATIONAL CONSIDERATIONS--MOGAS IN AVIATION

3.1 Material Compatibility

One of the concerns relating to the use of Mogas is the possibility of deterioration of elastomers (natural or synthetic rubbers or plastics) in the fuel system due to potentially incompatible Mogas constituents. This is not to imply that Avgas (100LL) is perfectly safe in this respect, for it is not, but the point is that the formulation of Mogas does not take into account its potential use in aircraft fuel systems and engines. Additives that appear in Mogas may be in use prior to sufficient compatibility tests in an aircraft environment.

A report from one aircraft owner has indicated that some swelling of "O" rings made of "Nitrile" or "Buna N" material (MS529513 type) has occurred while using Mogas. The operator claimed that the problem may be eliminated if the fuel drain, primer and selector valve "O" rings are converted to "Viton" material (available from Parker Hannifin). Similar deterioration problems with all aviation fuels have been seen with certain fuel hoses. The solution to this problem is contained in Aeroquip Service Bulletin AA135.

3.1.1 Alcohol

Fuels containing alcohol (methanol or ethanol) other than de-icing fluids are not permitted for use in aircraft. Alcohol can attack some seal and fuel system rubbers and plastics, resulting in potentially serious damage. Furthermore, alcohol and water will mix, and methanol may separate from gasoline. Since it is not required of fuel suppliers to indicate the presence of alcohol in gasoline, it is the responsibility of the pilot to ascertain its presence. Refer to Appendix A for methods of detecting the presence of alcohol.

3.1.2 MTBE

Methyl tertiary butyl ether (MTBE) is an octane boosting and carbon monoxide emission reducing additive which is an increasingly common component in Mogas. The FAA has recently (December 1992) approved the use of fuels containing MTBE while flying with U.S. STC's. Transport Canada continues to recommend increased scrutiny on elastomer components in engines and fuel systems due to the potential effects of MTBE or any other additive in Mogas. Suggestions of the type of periodic inspections recommended are outlined in Section 3.1.3..

3.1.3 Fuel System Monitoring

To address concerns of increased potential of elastomer deterioration, the following periodic checks are strongly recommended:

Fuel Sump Drains: Swelling or disintegration of the o-ring may result in blockage of the drain when it is opened or a constant slow leak when closed. This component is easily accessible and can therefore be frequently inspected.

Fuel Filter: Check frequently for particle accumulation. Deterioration of o-rings and elastomer type bladder fuel tanks may appear as sediment in the filter element.

Fuel Primer: Sticking may indicate swelled 0-rings. Replace o-ring ensuring that the replacement has the proper specifications and is compatible with the fuel in use. Monitor closely.

General: The frequency of functional checks on all fuel system control devices (fuel selector valves, fuel tank floats, etc.) should be increased while operating on Mogas.

3.2 Carburettor Icing

Mogas is generally higher in volatility than Avgas. Mogas will thus absorb more heat from the mixing air when vapourizing, resulting in ice accumulation at higher ambient temperatures. THE LIKELIHOOD OF CARB ICING WHILE FLYING ON MOGAS IS HIGHER.

Although the severity of the carb icing and the methods to deal with it are similar for both Avgas and Mogas, its ONSET is likely to occur at HIGHER AMBIENT TEMPERATURES and at LOWER HUMIDITY with Mogas. In other words, conditions under which a pilot may feel there is only a slight risk for carb icing on Avgas may in fact be ideal for the formation of ice while using more volatile Mogas. This will result in the need to select "carb heat on" in less severe icing conditions and for a longer duration while using Mogas.

TP 2700 is available from Transport Canada as a rough guide to conditions conducive to carburettor icing. Since this chart cannot take into account variances in fuel volatility, it should only be considered an approximate educational tool. Since the graph pertains to Avgas volatility fuel, the size of the risk areas would be larger with Mogas. A reproduction is provided in Appendix D.

The following should always be remembered while using Mogas:

- The onset of icing will result in a progressive power reduction leading to a loss of altitude and/or airspeed. With a fixed pitch propeller, a loss of RPM will be noticed. With a constant speed propeller, the RPM will remain constant, but the manifold pressure (MAP) will drop, and the same reduction in performance will be noticed. Engagement of carb heat should be the first reaction to this. The throttle should not be disturbed until there are signs of improvement. A further power loss will be noticed upon application of carb heat, but power will return when the ice has melted.

- DO NOT, in temptation to avoid the rough running associated with carb heat selected "on", select carb heat "off" too quickly. Sufficient time must be allowed for accumulated ice build up to melt.

- Failure to recognize the first signs of icing is a common cause of aviation accidents in conventionally carburetted aircraft. If carb heat is not applied, the initial power loss will continue until altitude may be impossible to maintain and engine roughness may lead to engine stoppage.

- An RPM or MAP drop due to the onset of icing while in descent may not be noticeable due to the reduced throttle setting. The engagement of carb heat whenever in descent is strongly recommended while using Mogas. During a descent it is recommended to periodically advance the throttle to ensure that full power is still available.

- Make sure during the pre-takeoff check that a good RPM drop is obtained when carb heat is selected.

- DO NOT be fooled by warm ambient temperatures. With the right humidity conditions, carb icing can easily occur at temperatures of 25 degrees C or higher, depending on fuel volatility.

- DO review the procedures outlined in your owners manual for dealing with carburettor icing.

3.3 Vapour Lock

Vapourization of fuel (boiling) can result in vapour blockages in fuel systems, thus starving the engine of a constant supply of liquid fuel. Due to the higher volatility of Mogas as compared to Avgas, the margin of safety in conditions conducive to vapour lock will be less with Mogas.

One common cause of vapour lock is "heat soak", where an engine, after running at full operating temperature, is shut down. Initially, the temperature of the engine compartment will actually rise due to the sudden loss of cooling air flow and the thermal mass of the hot engine. If the engine is started again shortly thereafter, the temperature of the fuel in the engine compartment may be beyond its initial boiling point, and thus the risk of vapour lock is at its highest. The risk is greater with Mogas, due to its lower initial boiling point.

In the situation of shutdowns of short duration, all means to cool the engine prior to the re-start should be taken, including opening of engine cowl flaps and/or the oil access door and then waiting for sufficient cooling to take place. After starting, the pilot should ensure that full power is available before entering an active runway. This also will replace hot fuel in the lines of the engine compartment with cooler fuel from the tanks. Another safety precaution is to drain about one quarter litre of fuel from the firewall sediment collection bowl (return this sample to the fuel tank) just prior to starting the engine. This also helps to ensure an initial flow of cooler fuel. Also, painting the wing area above wing tanks white or another light colour will reduce the tendency for fuel to heat up while the aircraft is exposed to the sun.

If vapour lock were to be encountered in flight, the first signs would be an increase in exhaust gas temperature (EGT) readings, since fuel flow would be restricted due to vapour formation. Unfortunately, few small aircraft have EGT readouts, nor would a change in this readout (if available) be readily noticed by a pilot. Engine running characteristics consistent with an interrupted fuel supply and roughness similar to running too lean would be signs of vapour lock in flight. The pilot should immediately reduce the throttle to the minimum required to sustain flight to reduce the fuel flow and hence reduce the formation of vapour. Normal throttle settings could be resumed when EGT readings settle down or when smooth running returns.

3.4 MOGAS Volatility Classes

Being aware of the higher volatility of Mogas as compared to Avgas is only part of the issue. A prime difference between the two is that Canadian Mogas is available to the consumer in 4 seasonal grades, each with different limits on vapour pressure, whereas Avgas has a single limit year round. The most serious implication to the Mogas pilot is that it is possible to obtain fuel from the volatility class of the previous season, as would be the case on a warm spring day fuelled with a high volatility winter class fuel. This situation would be the least safe scenario as far as both carb icing and vapour lock are concerned.

Transport Canada STRONGLY RECOMMENDS that the following be performed prior to fuelling each time with Mogas, particularly in the spring season:

- Test the fuel supply for vapour pressure to ensure that it meets the CAN/CGSB-3.5-92 (or more current issue) specification for maximum vapour pressure for that season (refer to Table 1 for more details). Vapour pressure test kits may be purchased. Contact your Regional Airworthiness Office for details. CAN/CGSB fuel specifications may be obtained from the CGSB Sales Unit (819) 956-0425 or by Fax (819) 956 5644.

It should not be assumed that using the correct volatility class for the date being flown removes the inherent increased risks of carb icing and vapour lock that are associated with Mogas. By testing, however, the pilot may be made aware of an unusually high vapour pressure by virtue of it exceeding the applicable limit, and thus could prevent himself from unknowingly entering into the potentially hazardous scenario described above.

Due to the inherently higher volatility of Mogas as compared to Avgas, it is always preferable in terms of reducing carburettor icing and vapour lock risks to use summer class volatility Mogas if given a choice. Be aware of which class you are purchasing and if possible use lower vapour pressure classes.

4.0 MOGAS - AVGAS PROPERTIES COMPARISON

4.1 General

Table 1 illustrates some of the differences for the common aviation fuel grades and Mogas. Parameters listed are limits as defined in CAN/CGSB-3.5-92 (Mogas) and ASTM D910 (Avgas) specifications.

It should be noted that automotive gasoline standard ASTM D439 has been replaced by ASTM D4814 which adds definitions and requirements for alcohol and other additives if used. FAA Advisory Circular 23.1521 states that "Autogas not containing alcohol or other oxygenates, conforming to D439 and D4814 are essentially identical and may be used interchangeably". Also, FAA AC 23.1521 is, at the time that this was written, in revision to allow the use of MTBE. As mentioned in Section 3.1.2., Transport Canada continues to recommend increased scrutiny on elastomer components.

The primary concerns with Mogas for use in aviation are its high and variable volatility and its formulation, namely its chemical composition and its additives. Carb icing and vapour lock as discussed in Section 3 are legitimate safety concerns, as is the fact that changes in formulation of Mogas are done with automobile usage in mind. Compatibility and suitability in aircraft applications are thus a continuing concern and therefore a close watch on fuel system components as recommended above is very important.

A significant amount of research has gone into the identification of the differences in properties between Mogas and Avgas and the resulting implications on aircraft engine operation and effects on aircraft fuel systems. A number of references are listed in Appendix B.

4.2 Lead Content in 100LL AVGAS

Lead content has been a problem with the acceptance of 100LL as a suitable replacement for the now scarce 80/87 and 100/130 Avgas. FAA Advisory Circular AC91-33 outlines some of the problems encountered with 100LL. These effects are summarized below.

The presence of lead in the fuel (100LL) and the bromine compound that is added to help scavenge the lead from within the cylinder will usually increase the amount of deposits in the combustion chamber. The following effects may be noted:

- valve sticking
- exhaust valve stem burning and head erosion
- intake valve head burning
- spark plug fouling and erosion
- piston ring sticking
- detonation

- pre-ignition
- lead deposits in oil

Despite the problems which may occur with a constant use of 100LL, it has been found that desirable lubricating properties may be gained by the occasional introduction of lead via the use of 100LL when operating regularly on unleaded Mogas. Petersen Aviation Inc. (the source of many U.S. Mogas STA's) recommends a tank full of 100LL every 75 hours of running on Mogas. Transport Canada agrees that this practice is beneficial.

Table 1: Fuel Properties

FUEL GRADE	COLOUR	ALLOWABLE VAPOUR PRESSURE (kPa)	LEAD mg/L MAX	SULPHUR % MASS MAX	GUM mg/ 100mL	MINIMUM ANTI-KNOCK INDEX (R+M)/2
"UNLEADED" MOGAS:						
regular	YELLOW	All grades*:	5	0.15	5	87
mid range	ORANGE		5	0.15	5	89
premium	RED	Summer 79 MAX	5	0.15	5	91
super	CLEAR	Spring 86 MAX	5	0.15	5	93
		Fall 97 MAX				
		Winter 107 MAX				
						OCTANE NO. LEAN/RICH
AVGAS 80/87**	RED	38-49	140	.05	6	80/87
AVGAS 100/130**	GREEN	38-49	1120	.05	6	100/130
AVGAS 100LL	BLUE	38-49	560	.05	6	100/130

*Actual dates of seasonal volatility classes vary by geographical region. Consult CAN/CGSB-3.5-92 for specific details. Note also that each grade (i.e. regular, mid grade etc.) has these same four seasonal classes.

**Phased out -- no longer available. Lead content values shown for all three Avgases are converted from mL TEL/US gal (using density of TEL as 1.657 Kg/L) as quoted in ASTM D910 specification to mg Pb/L using Pb as 64% of TEL by mass.

5.0 HANDLING AND STORAGE OF FUEL

5.1 Background

AIR 1-1 of AIP Canada contains a comprehensive section on this topic that applies equally to Mogas. Reading of this section in addition to the items below is strongly recommended.

While Transport Canada is accepting the use of automotive fuel in the aircraft and engines specified in this document, the supply and storage of this fuel is not under Transport Canada's jurisdiction. This falls under different Provincial and Federal regulations. The transportation of Mogas falls under the Federal Dangerous Goods Act. Information on this subject is available by contacting the Transport Canada Dangerous Goods Directorate, Ottawa, K1A 0N5, or your Regional Manager, Dangerous Goods.

Transport Canada acknowledges the present lack of suitable points of sale of Mogas for use in aircraft. Reluctance by oil companies to knowingly supply Mogas for this purpose has been a factor in preventing the proliferation of Mogas outlets with the same standards for dryness and cleanliness that are required for Avgas. As a result, Mogas use has gained a rather bad reputation when it comes to storage and handling. The widespread use of portable "jerry-cans", drums and a lack of appropriate water and particulate filtration are items which hold Mogas back as an accepted fuel. Airports are increasingly concerned by the safety hazards associated with aircraft owners fuelling from portable containers and oil companies will generally not consider knowingly distributing Mogas for aircraft use unless the cleanliness and dryness is ensured as it is with Avgas.

5.2 Filtered Mogas

Transport Canada STRONGLY RECOMMENDS that ALL Mogas dispensing systems for aviation use be equipped with 5 micron (or finer) filter/separators which respond to the presence of free water by shutting off (also called a "go/no-go" filter).

Filters chosen for this purpose should be specifically designed for fuel filtration. Appropriate filter equipment is available from several sources in Canada, one being Velcon Canada, (519) 622-7363. Please note that this information is given for your convenience and should not be construed as a formal endorsement by Transport Canada.

"Makeshift" filters such as those made of chamois or felt should only be used in emergencies, since filter fibres may clog fuel system filters and nozzles. After an emergency flight of this kind, the aircraft should be checked following approved maintenance instructions for a contaminated fuel system. Chamois or felt-lined filters also tend to build up an electrical charge as fuel passes through them and become ignition sources.

5.3 Quality Testing For Bulk Fuel Shipments

Increased acceptance of Mogas as a viable alternative will require it to be stored and handled more similarly to established aviation fuels than it has been thus far. Unlike Avgas, Mogas is not transferred in dedicated pipelines--it shares pipelines with other fuels such as diesel. The result is an increased risk of cross-contamination, or a mixture of two fuels due to a "slug" of the previously transported fuel remaining in the pipeline when the fuel being transferred is changed. The likelihood of cross-contamination occurring, although always remote, and also particulate contamination, increases with the number of fuel transfers en-route from the refinery to the final distribution point.

TP 11369, "Aviation Fuelling Policy" now supercedes TP 2231 (AK-66-06-000), "Aviation Fuelling Manual: Fuel Storage, Handling and Dispensing". Accompanying TP 11369 is TP 11370, "Aviation Fuelling Standards & Requirements", which acts as a guideline document. TP 11370 describes (amongst many other things) the methods used to test fuel for contamination at points of acceptance of a shipment, whether it be at an intermediate step in the fuel's transportation or at delivery to the final point of sale. Among these are the "Clear and Bright", "Free Water" and "Density" tests. Since adherence to the required fuel specification defined in this document (TP 10737) is only ensured at the refinery or bulk plant from which a fuel distributor will purchase his fuel, performance of these quality tests is crucial to ensure that no detrimental changes have occurred prior to sale of the fuel to the public.

Transport Canada recommends that any dedicated Aviation Mogas vendor perform a "Clear and Bright", a "Free Water" and a "Density test" on any shipments of fuel as delivered to the vendor's storage facility. Results of any such tests done at any transfer point previous to this final delivery will give clear evidence of a <u>change</u> in the fuel. The inherent variability of Mogas fuel density makes a <u>single</u> density measurement of limited use for establishing a change due to cross contamination.

5.4 Electrostatic Discharge

Gasoline will build up an electostatic charge whenever it is passed through a restriction or along a surface (i.e. a pipe). If appropriate measures are not taken to avoid this build up, serious fires/explosions may result. To avoid a spark from discharge of static electricity during flammable fluid filling operations, a wire bond should be provided between the storage container and the container being filled, unless a metallic path between the containers is otherwise present, such as a bonding wire built into the transfer hose.

5.5 "Jerry Cans"

As Mogas is used more, so does the use of portable fuel containers commonly called "jerry cans". Although convenient, they present some serious safety hazards and therefore are not recommended for use with Aviation Mogas.

Firstly, the concept of mandatory filtration and water separation does not lend itself to this method of fuel transfer. As a result, chances of fuel contamination by water and particulate matter increases. These cans in fact will far too often contain accumulations of dirt, water or unsuitable fuel which is far too easy to get into aircraft fuel systems.
Secondly, plastic jerry cans are particularly prone to static charge build up, since plastic is a non-conducting material and is virtually impossible to properly bond to the aircraft. Many accident reports have revealed that an arc was created when the can was pulled away at the end of the pour following sufficient charge accumulation. By this time the tanks are likely full and the results can be lethal.

5.6 Drum Storage

The practice of fuelling from drums is in some circumstances unavoidable, but is not recommended. The possibility of water contamination is high due to the tendency of drum tops to collect and hold water. Ingress of dirt matter into the drum via its openings and the potentially dirty nature of older drum linings are also concerns. Should the use of drums be necessary, Transport Canada again stresses the need for micronic and water go/no-go filtration as discussed in Section 5.2. Appropriate filters are available that are easily adapted to drum pumping arrangements. To aid in the prevention of water accumulation on drums, it is recommended that drums be stored on their side or at an angle.

5.7 Other Recommendations

- Buy Mogas from your FBO (Fixed Base Operator); or, from a major supplier at an airport facility, NOT from an automobile gas station or a bulk fuel plant.
- If your aircraft is not going to be used for 3 months or more, follow the manufacturer's instructions for starting up again after storage and fill up on fresh fuel (Mogas or Avgas). Long term storage of any fuel in the aircraft tanks should be avoided.
- As part of your daily check, drain settled-out water from the aircraft fuel tanks and fuel filter bowl. Dependent on the quality of fuel received and local conditions, more frequent drainage may be required.
- Excess water suspended in the fuel may cause ice crystals to form in cold weather. De-icing fluid may be used in accordance with approved instructions. Note that this is the ONLY form of alcohol acceptable for use in aircraft engines.

6.0 GETTING STARTED ON MOGAS

Before operating on Mogas, aircraft in categories 1, 2 and 4 of Table 2 (see sections 7 and 8) must comply with the following requirements:

- An entry shall be made in the aircraft technical log, Section II, and also the engine log, indicating that a Mogas STC has been installed (if Category 2) and/or that Mogas is being used under the acceptance of TP 10737 (all Categories).
- The engine log shall contain a complete record of all hours on Mogas including a record of mixtures used, if any (all Categories).
- The aircraft journey log shall be annotated such that Mogas may be used based upon the acceptance of TP 10737 (all Categories).
- The following placards should be installed at the indicated locations:

  Clearly visible at each fuel filler:

> 100LL AVIATION FUEL
> or
> UNLEADED AUTO GAS
> (Minimum anti-knock index 87)
>
> DO NOT USE GASOLINE CONTAINING ALCOHOL

Clearly visible in the cockpit:

> THIS AIRCRAFT MAY BE OPERATED
> ON UNLEADED AUTO GAS
> (MOGAS) OR MIXTURES OF MOGAS/AVGAS

Should there be a flight envelope restriction defined:

> RESTRICTED FLIGHT ENVELOPE
> WHILE OPERATING ON MOGAS:
> MAX. PRESS. ALT = X
> MAX. OAT = Y

where X and Y are unique to the particular approval.

- An entry in both the aircraft technical log and journey log shall be made to clearly indicate which Category (1, 2, or 4) of TP 10737 the aircraft is being operated under, and the current limits pertaining to the individual aircraft.

7.0 ENGINE AND AIRFRAME ELIGIBILITY CATEGORIES

7.1 Background

The aircraft eligible to use Unleaded Mogas fall into four (4) categories. The Minister of Transport is satisfied that operation of the airframe and engine combinations identified in Categories 1, 2, 3 and 4 (see sections 7.2 to 7.5) using Unleaded Automotive Gasoline (Canadian CAN/CGSB-3.5-92 or more current issue or U.S. ASTM D439 or D4814;) will not likely affect aviation safety. Accordingly, the Minister approves the use of Mogas for the four categories of aircraft, airframes and engines, provided the conditions are strictly observed.

A basic requirement for all categories is that the aircraft be powered by an engine or engines certified for 80/87 (or lesser octane) Avgas and having compression ratios of 7.65 or less. Engines of higher compression ratios may be eligible after specific modifications and/or test programs.

Whereas the FAA approvals of Mogas use do not allow the commercial carriage of passengers, Transport Canada does not distinguish between commercial and private carriage of passengers with regard to the use of Mogas. Therefore, commercial aircraft falling into the 4 categories are eligible to operate on Mogas, subject to any Airworthiness limitations or restrictions imposed by the FAA (where the application is for Category 1 and 2 aircraft), or by Transport Canada.

Note that Transport Canada requires that STCs on restricted category aircraft be familiarized and an STA issued to the STC holder. Also, the inter-relationship between a Mogas STC and any other fuel system STC or engine STC must be reviewed by Transport Canada or an appropriate Design Approval Representative (DAR). Please refer to AMA (Airworthiness Manual) Chapter 513/2 for categorization of Supplementary Type Certificates and Aircraft.

7.2 CATEGORY 1: Antique Aircraft

Antique aircraft are defined by the FAA as those aircraft and engine combinations type certificated on or prior to July 10, 1929. A U.S. STC is not required for aircraft in this category. For Antique Canadian Manufactured aircraft certificated after July 10, 1929, please refer to Appendix C or contact Transport Canada for a confirmation of eligibility in this category.

Using Canadian or U.S. standard Mogas, aircraft may be operated to the limits specified in the type certificate. Before operating on Mogas, aircraft in Category 1 must comply with the requirements set out in section 6.0 of this document.

7.3 CATEGORY 2: Airframes and Engines eligible for a U.S. Mogas STC.

Appendix E contains listing of FAA approved airframes and engines that may be purchased. In this category, both the engine STC and the airframe STC must be installed. If your aircraft falls into a special category defined in AMA 513/2, the STC must be familiarized by Transport Canada. In addition, other fuel system or engine STC's will need to be considered by Transport Canada or a DAR to review possible inter-relationships with your Mogas STC. Using Canadian or U.S standard Mogas, aircraft may be operated to the limits specified in the type certificate.

Some of the STC's issued in the U.S. for engines with compression ratios higher than 7.65:1 include the installation of Anti-Detonation Injection (ADI) Systems. It is required that such STC's also be familiarized by Airworthiness Headquarters in Ottawa prior to their installation on the aircraft.

The installation of a Mogas STC is considered to be a major modification, and as such requires the completion of a Repair on Modification Conformity Certificate, Form 24-0045, per the Airworthiness Manual, section 575.219. This certification must be completed and signed by an appropriately endorsed AME.

For aircraft imported with the Mogas STC installed, or for Canadian-registered aircraft having the work done in the U.S., the STC installation must be appropriately certified on an FAA 337 form.

Before operating on Mogas, aircraft in Category 2 must comply with the requirements set out in section 6.0 of this document.

7.4 CATEGORY 3: Airframes and engines NOT eligible for a U.S. Mogas STC.

Aircraft in this category are not eligible for an STC, are not classified as Antique under paragraph 7.2, and have not been approved under the Transport Canada Field Trial (Category 4). Approval in this category requires a Supplementary Type Approval program under the cognizance of Transport Canada, with an appropriate test program.

Aircraft using either Canadian or U.S. standard mogas shall be operated in accordance with limitations in the Supplementary Type Approval (STA), to be determined after an appropriate test program recognized by the Minister of Transport.

7.4.1 Envelope Expansion Procedures for Category 3

Aircraft in Category 3 may have been approved for a specific operating envelope other than the originally certified envelope as part of their STA. If the holder of a Category 3 STA wishes to expand the approved envelope, an amendment may be made to the STA upon successful completion of additional testing. Test requirements will be established at the time of application for envelope expansion. A separate STA for the expansion portion may also be issued to either the original STA holder or to an applicant who has purchased and installed the original STA on an appropriate aircraft/engine combination, following completion of additional testing.

An envelope expansion based on a previously issued Transport Canada (TC) STA still requires formal application, a compliance program, and a flight test proposal to be submitted for TC review and concurrence. TC will monitor all such programs since they require formal TC approval to change an STA's limitations or to issue another STA. Envelope expansion cannot exceed the aircraft's type certificated limits.

7.5 CATEGORY 4: Transport Canada approved under N-AME-AO 02/88

Table 3 lists the aircraft types previously approved under the terminated Mogas Field Trial under N-AME-AO 02/88. Category conversion eligibility is noted in Table 2 and must be utilized for expansion of the envelopes imposed on those aircraft approved. Aircraft in this category do not require a U.S. STC should they remain in Category 4 or are transferred to Categories 1 or 3.

Aircraft using mogas shall be operated in accordance with the maximum pressure altitude and maximum outside air temperature limitations set out in Table 3 of this document. Before operating on mogas, aircraft in Category 4 must comply with the requirements set out in section 6.0 of this document.

7.5.1 Envelope Expansion Procedures for Category 4

Envelope expansion may be accomplished only through conversion to Categories 1, 2, or 3. Category 4 aircraft ineligible for transfer to Category 1 or Category 2, must transfer to Category 3 and obtain an STA for envelope expansion.

8.0 AIRCRAFT AND ENGINE ACCEPTANCE AND LIMITATIONS

Table 2: Acceptance Categories, Limitations, and Options

	Category 1 ANTIQUE AIRCRAFT (Certified before 1929 July 10 or of Canadian Manufacture per Appendix C)	Category 2 FAA STC AVAILABLE (Required - See Appendix E)	Category 3 NO FAA STC AVAILABLE	Category 4 N-AME-AO 02/88 APPROVED
Limits	Certified Aircraft Limits	Certified Aircraft Limits	Limits TBD by STA Program	Current Limits Ref. Table 3
Envelope Expansion Procedures	Not applicable	Not applicable	Available by STA Ref. para 7.4.1	Not Available Must Transfer Category
Category Conversions	To Cat. 3	To Cat. 3	None	To Cat. 1, 2, or 3

The following table lists the final approval status of the Mogas Field Trial under N-AME-AO 02/88.

Table 3: Category 4 Approvals

APPROVED EQUIPMENT & FLIGHT LIMITATIONS				INFORMATION		
AIRCRAFT TYPE	ENGINE TYPE	MAX PRESS. ALT.	MAX. OAT	MAXIMUM REID VAPOUR PRESS. TESTED WINTER	SUMMER	APPROVAL DATE
Ayres S2R-R1340	P&W WASP R1340	3000 ft (or 900 m)	24°C	--------------	8.7 psig (60.5 kPa)	January 1988
Cessna 150 Series	Continental 0-200A	5500 ft (or 1650 m)	24°C	13.6 psig (93.8 kPa)	10.6 psig (73.3 kPa)	January 1988-91
				Cessna 150 series through to 150m are approved by similarity. Aerobats are <u>not</u> approved for aerobatic manoeuvres while operating on automotive gasoline.		
Cessna 18~~8~~ 2(?)	Continental 0-470R	4700 ft (or 1410 m)	24°C	--------------	9.6 psig (66.2 kPa)	March 1991
Fleet 80 Canuck	Continental 0-200A	6000 ft (or 1800 m)	26°C	13.6 (93.8 kPa)	10.6 psig (73.3 kPa)	January 1991
Fleet 80 Canuck	Continental 90 Series & 85 Series - carburetted versions only	6000 ft (or 1800 m)	26°C	Additional Fleet 80 approved by similarity to different engined Fleet 80.		August 1991
Grumman G164-A	P&W WASP R1340	3000 ft (or 900 m)	32°C	--------------	11.8 psig (81.6 kPa)	January 1989
Grumman G164, G164-B	P&W WASP R1340	3000 ft (or 900 m)	32°C	Additional Models of Grumman 164 approved based on similarity to Grumman G164-A.		January 1991

APPENDIX A

TEST METHODS FOR DETERMINING THE PRESENCE OF ALCOHOL IN FUEL

The two methods, described hereunder, are equivalents and are based on the property of alcohol to combine with water or ethylene glycol and therefore separate from gasoline.

Alcohol fuels could damage fuel systems and engines and therefore should not be used.

(a) Water method.

(1) In a small diameter transparent cylinder, put approximately 10mL of water and clearly mark the level.

(2) Add approximately 100mL of test fuel.

(3) Shake vigorously, then let stand.

(4) If after settling it is apparent that the water volume at the bottom has increased, alcohol is present.

(b) Ethylene glycol method.

(1) In a small diameter transparent cylinder, put approximately 100mL of test fuel and clearly mark the level.

(2) Add approximately 10mL of ethylene glycol.

(3) Shake vigorously, then let stand.

(4) If after settling it is apparent that the fuel volume at the bottom has decreased, alcohol is present.

APPENDIX B

REFERENCES FOR FURTHER INFORMATION

1. FAA Advisory Circular AC 23.961-1
   Procedures for Conducting Fuel System Hot Weather Operation Tests
2. AIP Canada AIR 1-1, Section 1.2.2
   Fuel Handling
3. FAA Advisory Circular AC 91-33
4. EAA Field Info No. 8501
5. Specification ASTM-D439
6. Specification ASTM-D4814
7. Specification CAN/CGSB-3.5-92
8. N-AME-AO 02/88 Field Trial of Automotive Gasoline (Mogas) for General Aviation Aircraft
9. N-AME-AO 14/88 Familiarization of FAA Supplemental Type Certificates (STCs)
10. FAA Advisory Circular AC 23.1521
11. Airworthiness Manual, Chapter 575, Section 575.219
12. TP 11369, "Aviation Fuelling Policy"
13. TP 11370, "Aviation Fuelling Standards and Requirements".

APPENDIX C

CANADIAN MANUFACTURED ANTIQUE AIRCRAFT

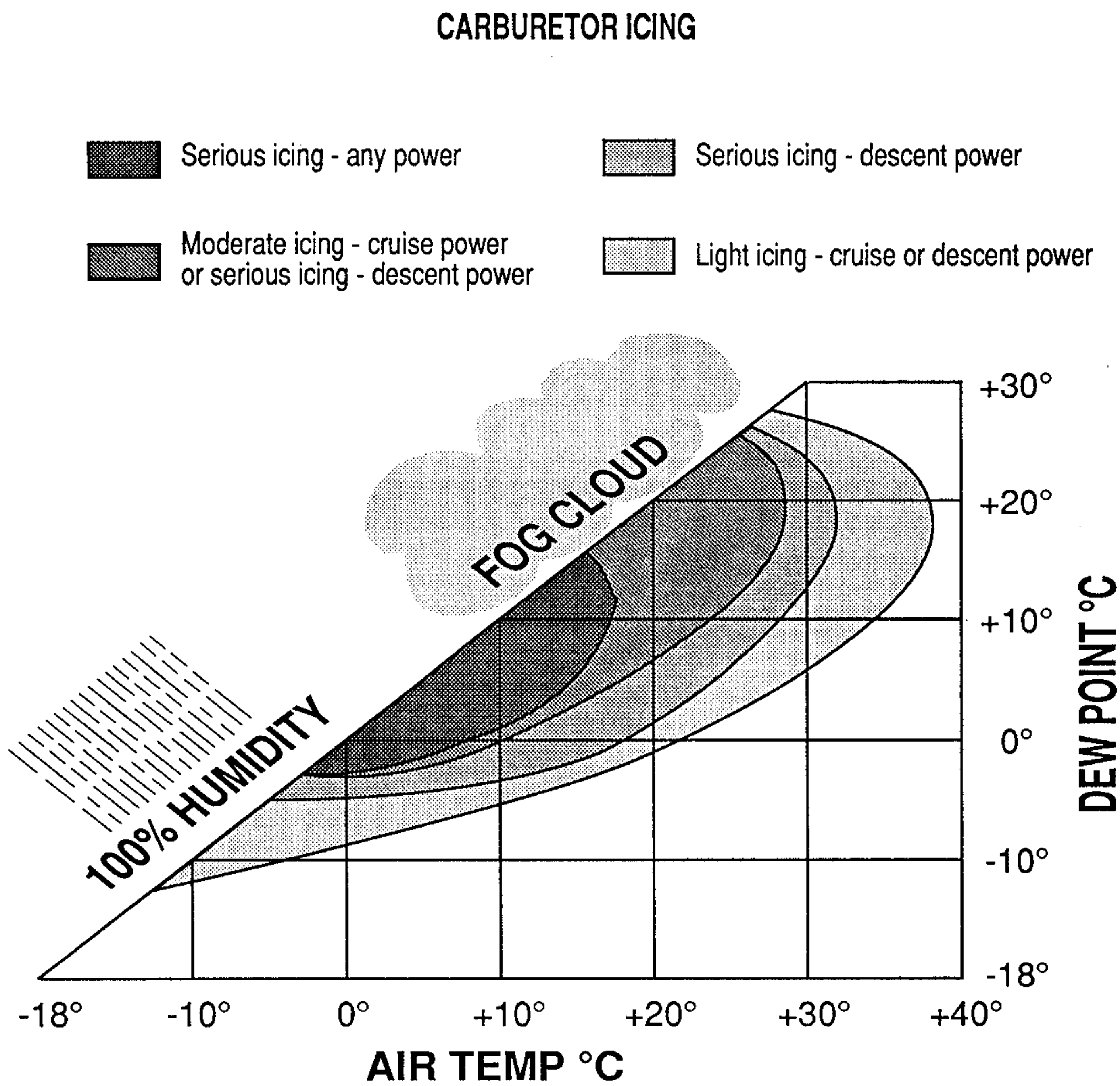
The following Canadian Manufactured aircraft have been designated "**Antique**" for the purposes of using Automotive Gasoline (Mogas) under Category 1 as listed in Table 2 and explained in section 4.2 of this document:

AIRCRAFT		ENGINE(S) ELIGIBLE
DH60GM	Moth	DH Gipsy II
DH82C	Tiger Moth	DH Gipsy Major 1C
DH82A		DH Gipsy Major 1
DH83C	Fox Moth	DH Gipsy Major 1C
DH87B	Hornet Moth	DH Gipsy Major 1C
Fairchild 71C		PW Wasp Jr. SB-3 or MIL. R985-AN2/-AN4/-AN6/-AN8/-AN10/-AN12/-AN12B/-AN14B
Fairchild 82A		PW Wasp Jr. or R985-AN12B/-AN14B
Fairchild 82D		PW Wasp Jr. or R985-AN12B/-AN14B

Listed aircraft incorporating alternate engines not shown above may require an engine STC/STA. Please contact Transport Canada Airworthiness for further information.

APPENDIX D

TP 2700 - CARBURETTOR ICING CONDITIONS



APPENDIX E

U.S. FAA SUPPLEMENTARY TYPE CERTIFICATES (STCs)

AVAILABLE FOR PURCHASE

The following listings of U.S. STCs are provided for information purposes so that owners whose aircraft fall into Category 2 of Table 2 may contact either agency if purchase of an STC is intended. The STC holders are:

Experimental Aircraft Association (EAA)
EAA Aviation Centre
Oshkosh
Wisconsin 54903-3065
(414) 426-4800

Petersen Aviation Inc.
Rt. 1, Box 18
Minden
Nebraska 68959
(308) 832-2050
FAX (308) 832-2311

PETERSEN AVIATION, INC.
RT. 1, BOX 18
MINDEN, NEBRASKA 68959
U.S.A.
308/ 832 2050 FAX 308/ 832 2311

AIRFRAMES APPROVED FOR AUTOMOTIVE FUEL
87 or 88 Octane Minimum Mogas Leaded or Unleaded
except
Cessna 210 G, H, J, K, L, M, N, A188 , A188B &
Beech Baron D55, D55A, E55, E55A, 95-C55, 95-C55A,
and 58 & 58A thru S/N TH-1395 except TH-1389
(the preceding requires water/alcohol injection & 91 octane fuel)

160 HP 0-320 (except H2AD), 180 HP 0-360, & Cessna 152's (0-235's)
are approved for 91 octane minimum!

Airframes specifically approved for the installation of 91 octane STC's not requiring water/alcohol injection are denoted with an * for 160 hp 0-320 and with a ° for 180 hp 0-360 engines. Please note that electric fuel pump equipped Cessna 172's are not approved for installation of the 0-360 auto fuel STC. Please phone for clarification.

Aeronca	15AC, S15AC, 65-TC, YO-58, 65-TAC
Aero Commander	10, 100, 10A, 100A
Air Tractor	AT-300, AT-301
Ayres	S-2C and 600 S-2C, Serial Nos. 1163C & 600-1163C thru 1526C or 600-1526C only 600-S2D, S-2R, S2R-R1340,
Beech	AT-11, SNB-1, D18S, E18S, C45G, TC-45G, C-45H, TC-45H, TC45J, UC-45J, (SNB-5), RC45J (SNB-5P), E-18S-9700, G-18S, H-18, URB-6, 3N, 3NM, 3TM D17S, 35, A35, B35, C35, D35, E35, F35, G35, 35R, 35-33, 35-A33, 35-B33, 35-C33, E33, F33, 95-B55, (95-B55A) S/N TC-502 and on, 95-B55B (T42A) D55, D55A, E55, E55A,95-C55, 95-C55A, and 58 & 58A thru S/N TH-1395 except TH-1389
Bellanca	11AC, S11AC, 11BC, S11BC, 11CC, S11CC, 8GCBC
Bellanca (Champion) (Aeronca)	7GCAA, 7GCBC, 7AC, S7AC, 7BCM, 7CCM, 7DC, S7DC, S7CCM, 7EC, S7EC, 7FC, 7GC, 7HC, 7GCA, 7JC, 7GCB, 7KC, 7GCBA, 7ECA
Boeing	75 (PT-13), A75 (PT-13A, -13B, -13C), B75 (N2S-2), E75 (PT-13D, NS2-5, PT-13D/N2S-5), A75J1 (PT-18), A75L300, A75N1 (PT-17, -17A, N2S-1, -4) B75N1 (N2S-3), D75N1 (PT-27), IB75A, E75N1, A75L3
Brewster	Fleet 7
Callair	A-9, A-9A

Cessna	120, 140, 140A, 150, 150A thru 150M, A150K, A150L, & A150M, 152, A152, 170Â, 170B, 172, 172A, B, C, D°, E°, F°, G°, H°, I*°, K*°, L*°, M*°, N*°, P*°, 175,175A, 175B, 175C, P172D, 177, 180, 180A, 180B, 180C, 180D, 180E, 180F, 180G,180H, 180J, 182, 182A, 182B, 182C, 182D, 182E, 182F, 182G, 182H, 182J, 182K, 182L, 182M, 182N, 182P, 188, 188A, 188B, A188 , A188B, 190,195, 195A, 195B, 210 A, B, C, G, H, J, K, L, M, N, 305A,305C, 305D, 305F, USAFO-1A, 0-1E, 0-1G, 305B, 305E, TO-1D, 0-1D, 0-1F
Christen	A-1
De Havilland	DHC-2MKI
Douglas	DC3A-SCG, -SC3G, -S1CG, -S1C3G & -S4C4G, DC3C-SC3G, -S1C3G, -S4C4G, DC3C-R-1830-90C, DC3D-R-1830-90C
Fairchild	24R, 24W, 24C8C & 24C8CS
Funk	B, B75L, (Army UC-92), B85C
Grumman	G-164, G-164A, G-164B, [G-21 (Goose), must have Pesco P/N 2E608 electric fuel pumps]
Gulfstream American	AA-5, AA-5A
Globe (Temco)	GC-1A & GC-1B
Great Lakes	2T-1A-1
Harvard	Mk 1 & Mk II (STA available on Mk IV)
Howard	DGA-15P
Luscombe	8 Series thru 8F and T-8F Models (must have gravity fuel feed wing fuel tanks as the main fuel supply to the carb) Airframe STC for fuselage tank equipped Luscombe's available from: Steve Hinckley, 6528 Spring River Lane, North Richland Hills, TX 76118, 817/281-4202
Maule	M-4, M-4C, M-4S, M-4T
North American	BC-1A, AT-6 (SNJ-2), AT-6A (SNJ-3), AT-6B, AT-6C (SNJ-4), AT-6D (SNJ-5), AT-6F (SNJ-6), SNJ-7, T-6G
Piper	PA-11, PA-11S, PA-12, PA-12S, PA-14, PA-15, PA-16, PA-16S, PA-18*°, PA-18S*°, PA-18 "105"*°, PA-18S "105"*°, PA-18A*°, PA-18 "150"*°, PA-18A "150"*°, PA-18S "150"*°, PA-18AS "150"*°, PA-18S "135"*°, PA-18AS "135"*°, PA-18 "125"*°, PA-18S "125"*°, PA-18 "135"*°, PA-18A "135"*°, PA-19*°, PA-19S*°, PA-18A "150" restricted category*°, PA-20, (series*) PA-20S, PA-20 "115", PA-20S "115", PA-20 "135", PA-20S "135, PA-22, PA-22-108, PA-22-135, PA-22S-135, PA-22-150, PA22S-150, PA-22-160*, PA-22S-160*, PA-23, PA-23-160*, PA-25-150, PA-25-235 (restricted and normal category) PA-23-150, PA-28-140, 150, 151, PA-28-160*, -161*, -180°, -181°, Serial # 28-1761 to 5859, 28-7105001 to 28-7505261, 28-7690001 to 28-8590001 and up, PA-28-235, PA-36-285, J3C-65, J3C-65S, J4E, J4A-S, (L-4E)

Spartan 7W

Stinson 108, 108-1, 108-2, 108-3, L-5, -5B, -5C, -5D, -5E, -5E-1, -5G, SR-5, -5A, (Army L-12), -5B, -5C, -5E

Taylorcraft BC-65, BCS-65, BC12-65, (ARMY L-2H) BCS12-65, BC12-D, BCS12-D, BC12-D1, BCS12-D1, BC12D-65, BC12-D, BCS12-D, BC12-D1, BCS12-D1, BC12D-85, BCS12D-85, BC12D-4-85, BCS12D-4-85, 19, F-19, DC-65 & DCO-65

Varga 2150A

Waco UPF-7 & VPF-7, YKC, YKC-S, YKS-6, ZKS-6, YMF

Weatherly 620, 201, 201A, 201B, 201C

Canadian STA'S

DeHavviland DHC-2 MK. I (Beaver) SA90-99

Piper PA-25-235 (Pawnee-Restricted Category) SA89-64

Harvard Mk IV SA92-112

PETERSEN AVIATION, INC.
RT. 1, BOX 18
MINDEN, NEBRASKA 68959
832-2050 U.S.A. 832-2311
308/~~237-9330~~ FAX 308/~~234-5692~~

ENGINES APPROVED FOR AUTOMOTIVE FUEL
87 or 88 Octane Minimum Mogas Leaded or Unleaded
Engines requiring 91 octane minimum are noted with an *.
Engines requiring water/alcohol injection are noted separately.

FRANKLIN

6A4-150-B3, B4, B31, 6A4-165-B3, B4, B6

CONTINENTAL

A-65-1, -3, -6, -6J, -7, -8, (0-170-3, -7)-8F, -8FJ, -8J, -9, (0-170-5), -9F, -9FJ, -9J, -12, -12F, -12FJ, -12J, -14, -14F, -14FJ, -14J

A-75-3, -6, -6J, -8, -8F, -8J, -8FJ, -9, -9J

C-75-8, -8F, -8FH, -8FHJ, -8FJ, -8J, -12, -12F, -12FH, -12FHJ, -12FJ, -12J, -12B, -12BF, -12BFH, -15, -15F, C85-8, -8F, -8FHJ, -8FJ, -8J, -12, -12F, -12FH, -12FHJ, -12FJ, -12J, -14F, -15, -15F

C-90-8F, -8FJ, -12F, -12FH, -12FJ, -12FP, -14F, -14FH, -14FJ, -16F, 0-200-A, 0-200-B, 0200-C

C-115-1, C-115-2, C-125-1, C-125-2

E-165-2, -3, -4, E-185-1, -2, -3, (0-470-7, -7A), -5, -8, -9, (0-470-7B), -10, -11

E-225-2, -4, -8, -9

0-300-A, -B, -C, -D, -E, C-145-2, -2H, -2HP.

GO-300-A, -B, -C, -D, -E, -F

0-470-A, -E, -J, -K, -L, -R, -S.

0-470-4, -11, -11B, -11-CI. -11B-CI, -13, -13A, -15

IO-470-J & -K

I0-470-D, -E, -F, -L, -LO, -M, -S, -U, -V, -VO, -G, -R, -H, -N, -P, -T; LIO-470-A (water/alcohol injection and 91 octane fuel required for this series of engine)

W670-6A, (R-670-3, -5), -6N, (R-670-4), -16, (R-670-8, -11, -11A), -23, -24, -K, -M

I0-520 - A, -B, -BA,- BB, -C, -CB, -D,- E, -F, -J,- K,- L, -M, -MB,- NB (water/alcohol injection and 91 octane fuel required for this series of engine)

LYCOMING

0-145-B1, -B2, -B3, -C1, -C2, GO-145-C1, -C2, -C3, -A1, -A2

0-235-C, -C1, -C1B, -E1, -E1B, -C1C, -C1A, -H2C, -C2A, -C2B, -E2A, -E2B

*0-235-L2A, -L2C, -M1, -M2C, -M3C, -N2A, -N2C, -P1, -P2A, -P2C, -P3C

0-290, -A, -AP, -B, (0-290-1), -C, (0-290-3), -CP, -D, (0-290-11), -D2, -D2A, -D2B, -D2C

0-320, 0-320-A1A, -A1B, -A2A, -A2B, -A2C, -A2D, -A3A, -A3B, -A3C, -C1A, -C1B, -C2A, -C2B, -C2C, -C3A, -C3B, -C3C, -E1A, -E1B,- E1C, -E1F, -E2A, -E2B, -E2C, -E2D, -E2F, -E2G, -E2H, -E3D, -E3H, -E1J.

*0-320 - B1A, -B1B, -B2A, -B2B, -B2C, -B3A, -B3B, -B3C, -D1A, -D1B, -D1C, -D1D, -D1F, -D2A, -D2B, -D2C, -D2F, -D2G, -D2H, -D2J, -D3G.

*0-360-B1A, -B1B, -B2A, -B2B, -D1A, -D2A, -D2B, -A1A, -A1AD, -A1C, -A1D, -A1F, -A1F6, -A1F6D, -A1G, -A1G6, -A1G6D, -A1H, -A1H6, -A1LD, -A2A, -A2D, -A2E, -A2F, -A2G, -A2H, -A3A, -A3AD, -A3D, -A4A, -A4AD,-A4D, -A4G, -A4J, -A4K, -A4M, -A4N, -A5AD, -C1A, -C1C, -C1E, -C1F, -C1G, -C2A, -C2B, -C2C, -C2E, -F1A6, -G1A6

0-435, 0-435-A, 0-435-C (0-435-1), 0-435-C1, (0-435-11), 0-435-C2 (0-435-13)

0-540-B1A5, -B1B5, -B1D5, -B2A5, -B2B5, -B2C5, -B4A5, -B4B5

*0-540-A1A, -A1A5, -A1B5, -A1C5, -A1D, -A1D5, -A2B, -A3D5, -A4A5, -A4B5, -A4C5, -A4D5, -D1A5, -E4A5, -E4B5, -E4C5, -G1A5, -G2A5, -H1A5, -H2A5, -H1A5D, -H2A5D, -H1B5D, -H2B5D.

*[R-680-E3, E3A, E3B, (R-680-9, -13) 91 OCTANE MINIMUM, THESE MODELS R-680 ONLY]

R-680, R-680-E1, E2, -6, -B6, -D5, -D6, -B2, -BA, -2, -4, -B4, -B4B, -B4C, -B4D, -B4E, (R-680-5, -7, -8, -11, -17) R-680-5, -B5

PRATT & WHITNEY

R-985-13, -17, -19, -23, -25, -27, -39, -39A, -48, -50, -AN-1, -AN-1M1, -AN-2, -AN-3, -AN-4, -AN-5, -AN-6, -AN-6B, -AN-8, -AN-10, -AN-12, -AN-12B, -AN-14B, -AN-14BMI, T1B2, T1B3, B-4, B-5, SB, SB-2, SB-3

R-1340-E, -19, -22, -29, -36, -40, -47, -49, -49M1, -51, -AN-1, -AN-2, -51M1, -53, -57, -59, -61, S1D1, S3H1, S3H1G, S1H2, S1H1, S1H4, S3H2

R-1830-49, -53, -57, -82, -92, -92A, -96, SC-G, SC3-G, S1C-G, S1C3-G, S4C4-G, R-1830-43, -43A, -61, -65, -67, -75, -86M2, -90B, -90C, -90D, -94, -94M1, -94M2, S3C4-G

JACOBS

R-755A1, R-755A2, R-755B1, R-755B2, L-6, -6M, -6MA, -6MB, -6MBA, (R-915-3, -5, -7), L-4, -4M, -4MA, -4MA7, -4MB, (R-755-9), L-5, -5M, -5MB, R-755-7.

WARNER

Super Scarab 40, 50 (R-500-2), 50 A (R-500-4, -6)
Scarab Series 28, 29, 30, 40, 50
Super Scarab 165 (R-500-1, -7), 165-A, 165-B, 165-D
Super Scarab 185, 185J (R-550-1, -3), 185K.

CANADIAN STA'S

0-540-B1A5, -B1B5, -B1D5, -B2A5, -B2B5, -B2C5, -B4A5, -B4B5

0-320, 0-320-A1A, -A1B, -A2A, -A2B, -A2C, -A2D, -A3A, -A3B, C1A, C1B, C2A, C2B, C3A, E1A, E2A, E2B, E2C, E2D, E2G, E2H, E3D, E3H

ENGINE MODELS APPROVED

For use of autogas in airframes listed on reverse side of this page. The cost of the STC package, (airframe, engine, and placards) is based on engines models as follows:

TELEDYNE CONTINENTAL ENGINES

A-40, -2, -3, -4, -5
A-50-1, -2, -3, -4, -5, -6, -7, -8, -9
A-65-1, -3, -6, -7, -8, -9, -12, -14, (O-170-3, -5, -7)
A-75-3, -6, -8, -9
C-75-8, -12, -15
C-85-8, -12, -14, -15
C-90-8, -12, -14, -16
C-125-1, -2
E-165-2, -3, -4
E-185-2, -5
E-185-1, -3, -8, -9, -10, -11
C-145-2, -2H, -2HP
O-200-A, -B, -C
O-300-A, -B, -C, -D, -E
GO-300-A, -B, -C, -D, -E, -F
E-225-2, -4, -8, -9
O-470-A, -E, -J
O-470-K, -L, -R, -S
O-470-11, -11B, -15
O-470-4, -13, -13B

AVCO LYCOMING ENGINES

O-235-C
O-235-C1, -C2, -E1, -E2
O-235-H2
O-235-L2C, -K2C (M) (modified for 80 octane)
O-290, O-290-A, -AP, -B, -C, -CP, -D
O-290-D2, -D2A, -D2B, -D2C
O-320-A, -C, -E
O-540-B1A5, -B1B5, -B1D5, -B2A5,
-B2B5, -B2C5, -B4A5, -B4B5

EAA **AIRFRAME APPROVALS**

AERO COMMANDER Inc. S.L. Industries

100

AERONCA Inc. Bellanca, Champion, Trytek
Wagner, B & B Aviation

Most models including the 7 series and 11 series. *7KCAB

ARCTIC AIRCRAFT CO. INC. Inc. Interstate

S-1A, *S-1B1, S-1B2

BEECHCRAFT Inc. Bonanza

35, A-35, B-35, C-35, D-35, E-35,
F-35, G-35, 35R

CESSNA

120, 140, 140A
150, 150A-H, 150J-M, A-150K-M
**152, **A152
170, 170A, B
172, 172A-E, 172F(T-41A), 172G, 172H, P172D
172I, K, L, M
175, 175A, B, C
177
180, 180A-H, 180J
182, 182A-P
305A(O-1A), 305B, 305E(TO-1D, O-1D, O-1F)
305C(O-1E), 305D(O-1G), 305F

COMMONWEALTH Inc. Skyranger and Rearwin

175, 180, 185

ERCOUPE Inc. Airco, Skyranger and Rearwin

415C, D, E, G, 415-CD
F-1, F-1A,
A-2, A-2A
M10

FUNK Inc. McClish
B-85C

GRUMMAN Inc. Gulfstream American

AA-1, -1A, -1B, -1C
AA-5, -5A, *AA-5B

LUSCOMBE Inc. Temco

8 series, 11A

MAULE

M-4 (most models)

MOONEY

M-18C, -18C55, -18L, -18LA

PIPER

E-2
J-2
J-3 (most models)
J-4 (most models)
J-5 (most models)
PA-11 (most models)
PA-12 (most models)
PA-14
*PA-15
PA-16
PA-17
PA-18 (all models)
PA-19 (all models)
PA-20 (all models)
PA-22 (most models)
PA-28-140
PA-28-150
PA-28-151

PORTERFIELD Inc. Rankin and Northwest

CP-55, CP-65, CS-65

STINSON

*108 Series
HW-75
10

SUPERIOR AIRCRAFT CO., INC. Inc. Culver Cadet

LCA, *LFA

TAYLORCRAFT

A, BC (most models)

YARGA

2000C, 2150, 2150A, 2180

NOTE: *Airframe approvals only. ** Requires engine modification