

G100UL™

High Octane Unleaded Avgas

(Presented at Oshkosh, July 28, 2021)

In 2010, GAMI made a promise to undertake the “Holy Grail” - - to “Get the Lead out!”

**July 27, 2021 - -
GAMI achieved that Goal.**

General Aviation Modifications, Inc.
Engineering the Future of General Aviation



Taxpayers are conditioned to think of "research" as what is done in universities by people with government grants. Actually, research is what was done by the Wright brothers with their own money.™

Dr. Thomas E. Phipps, Jr.



Coffee Mug In The Engine Test Stand Control Room



GAMI has been researching high octane unleaded avgas solutions since 2003.

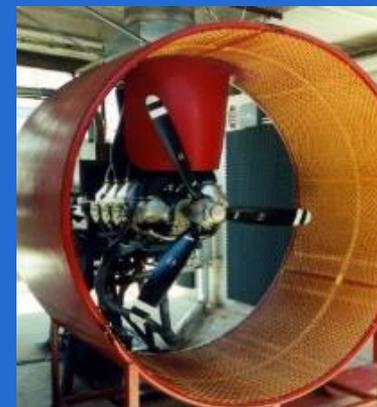
From 2002 through 2009 - - Three different major refineries of Avgas have, at various times, engaged GAMI to use our detonation test facility to conduct research on candidate unleaded Avgas formulation.

All three of those fuels failed to provide adequate detonation margins.

From that experience and knowledge base as to why those three fuels failed to be a suitable replacement fuel, GAMI decided, in late 2009, to formulate a fuel with adequate octane and operating characteristics and to seek FAA Certification of that fuel for the General Aviation Fleet.

GAMI's Aircraft Piston Engine Test Facility:

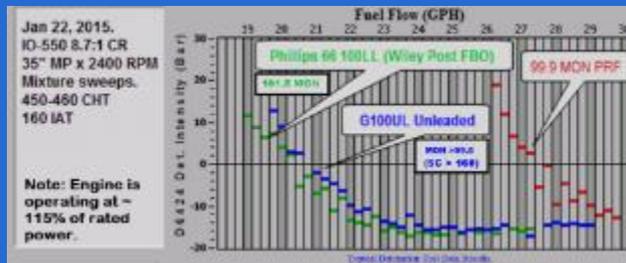
To our knowledge, there is only one other aircraft piston engine test facility in the country with similar capabilities.



The goal was:

An FAA AML STC

Approving a commercially producible and economically viable unleaded avgas for all aircraft & spark ignition piston engines that presently require the use of 100LL for detonation margins.





United States of America
Department of Transportation
Federal Aviation Administration

Supplemental Type Certificate

Number SA01967WI

This certificate issued to: General Aviation Modifications, Inc.
2800 Airport Road, Hangar A
Ada, OK 74820

Certifies that the change in the type design for the following product with the limitations and conditions therefore as specified hereon meets the airworthiness requirements of Part 23 of Code of Federal Regulations
Make: _____

Original Product _____

Type Certificate Number: _____

Description of Type Design Change: _____

Model: See attached FAA Approved Model List (AML)
No. SA01967WI, for all aircraft makes, models and certification basis.

Use of GAMI G100UL High Octane Unleaded Avgas on aircraft listed in the attached AML.
Add the following approved fuel: unleaded aviation gasoline per GAMI Specification G100UL-12C-2, or later FAA Accepted revision.
Comingling is approved with ASTM Grade 100LL aviation gasoline and other gasolines with 100 MON or less, including MoGas, where those gasolines are also approved for the same make and model engines.

See attached STC AML No. SA01967WI for all required data.

Limitations and Conditions:

1. Specific approval must be obtained for each model aircraft to ensure compatibility with its fuel system.
2. Compatibility of this design with previously approved modifications must be determined by the installer.
3. STC SE01966WI must be previously installed.

This certificate and the supporting data which is the basis for approval shall remain in effect until surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator of the Federal Aviation Administration.

Date of Application: October 6, 2020 Date Reissued: _____

Date of Issuance: July 23, 2021 Date Amended: _____

By Direction of the Administrator

Signature: Paul Nguyen
Paul Nguyen
Manager, AIR-7KO
Title: Wichita ACO Branch

Any alteration of this certificate is punishable by a fine of not exceeding \$1,000, or imprisonment not exceeding 3 years, or both. This certificate may be transferred or made available to third persons by licensing agreements in accordance with 14 CFR 21.47. Possession of this Supplemental Type Certificate (STC) document by persons other than the STC holder does not constitute rights to the design data nor to alter an aircraft, aircraft engine, or propeller. The STC's supporting documentation (drawings, instructions, specifications, flight manual supplements, etc.) is the property of the STC holder. An STC holder who allows a person to use the STC to alter an aircraft, aircraft engine, or propeller must provide that person with written permission acceptable to the FAA. (Ref. 14 CFR 21.120).



United States of America
Department of Transportation
Federal Aviation Administration

Supplemental Type Certificate

Number SE01966WI

This certificate issued to: General Aviation Modifications, Inc.
2800 Airport Road, Hangar A
Ada, OK 74820

Certifies that the change in the type design for the following product with the limitations and conditions therefore as specified hereon meets the airworthiness requirements of Part 33 of Code of Federal Regulations
Make: _____

Original Product _____

Type Certificate Number: _____

Description of Type Design Change: _____

Model: See attached FAA Approved Model List (AML)
No. SE01966WI, for all engine makes, models and certification basis.

Use of GAMI G100UL High Octane Unleaded Avgas in spark ignition piston aircraft engines.
Add the following approved fuel: unleaded aviation gasoline per GAMI Specification G100UL-12C-2, or later FAA Accepted revision.
Comingling is approved with ASTM Grade 100LL aviation gasoline and other gasolines with 100 MON or less, including MoGas, where those gasolines are also approved for the same make and model engines.

See attached STC AML No. SE01966WI for all required data.

Limitations and Conditions:

1. Specific approval must be obtained for each model aircraft to ensure compatibility with its fuel system.
2. Compatibility of this design with previously approved modifications must be determined by the installer.
3. This approval should not be extended to other specific engines of these models that incorporate any other previously approved modification, unless it is determined that the interrelationship between this change and any of those other previously approved modifications will introduce no adverse effect on the airworthiness of the engine.

This certificate and the supporting data which is the basis for approval shall remain in effect until surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator of the Federal Aviation Administration.

Date of Application: October 1, 2020 Date Reissued: _____

Date of Issuance: July 23, 2021 Date Amended: _____

By Direction of the Administrator

Signature: Paul Nguyen
Paul Nguyen
Manager, AIR-7KO
Title: Wichita ACO Branch

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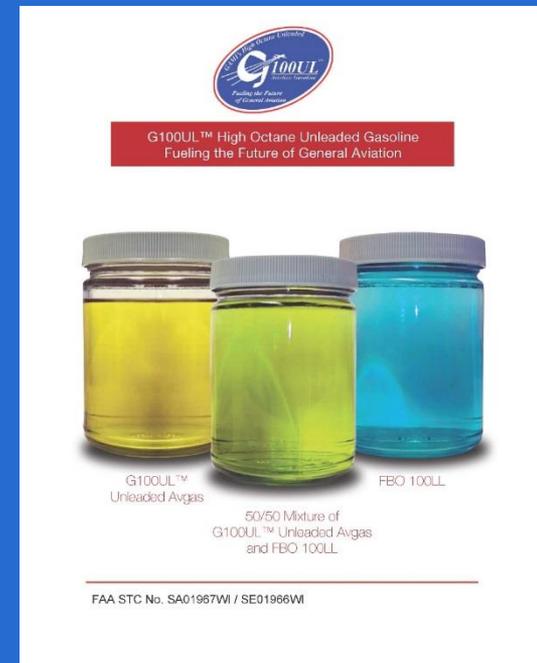
Promise Kept Oshkosh - - July 27, 2021

Requirements for a practical replacement unleaded Avgas for ASTM D910 100LL:

- 1) Octane ~ same as 100LL;
- 2) Fungible with 100LL in the FBO tanks and the wing tanks of the aircraft (includes material compatibility);
- 3) Can be produced within existing industrial refining facilities;
- 4) Cost ~ comparable with 100LL;
- 5) Fleet wide “All Aircraft – All Engines” FAA approval.



General Aviation Modifications, Inc.
Engineering the Future of General Aviation





G100UL™ High Octane Unleaded Gasoline
Fueling the Future of General Aviation



G100UL™
Unleaded Avgas

FBO 100LL

50/50 Mixture of
G100UL™ Unleaded Avgas
and FBO 100LL

**G100UL
Avgas is
completely
“fungible”
with all other
gasolines
approved for
use in general
aviation
gasoline.**

Aircraft _____ Serial No. _____
Make/model

Engine(s) _____ Serial No.(s) _____
Make/model

LOG OF REVISIONS

| Revision | Pages | Date | Description | FAA Approved |
|----------|-------|-----------|---------------------|--------------|
| IR | All | 7-12-2021 | Complete Supplement | KENT S LUND |
| | | | | |
| | | | | |
| | | | | |

SECTION 1 – GENERAL

This supplement provides information to be used when operating aircraft and engines with G100UL avgas. Keep this document in the airplane cockpit within reach of the pilot.

Description

G100UL aviation gasoline (avgas) is an unleaded high octane avgas that may be used in place of, or in any combination with, ASTM D910 100LL, or a type approved avgas with motor octane number lower than 100. G100UL avgas is not dyed like blue leaded aviation gasoline. G100UL avgas may appear yellow to dark amber in color, depending on the constituents in the fuel.

SECTION 2 – LIMITATIONS

Fuel Limits

APPROVED FUELS

Use Grade G100UL avgas in any combination with fuels approved for use on aircraft/engines that are approved for operation on Grade 100LL and/or aviation fuels that have Motor Octane Numbers lower than 100.

CAUTION: DO NOT MIX G100UL AVGAS WITH MOTOR GASOLINE (MOGAS) THAT CONTAINS ET-HANDLER/MET-HANDLER

For aircraft that currently approve its use, isopropyl alcohol in amounts not to exceed 1% by volume can be added to G100UL or a mixture of G100UL and 100LL avgas to prevent ice formation in fuel lines and tanks. Be sure that isopropyl alcohol does not exceed the 1% by volume of the total amount of avgas or avgas mixture in the tank.

When mixed with 100LL avgas the G100UL avgas may change the color of the fuel mixture to a color that does not match the color of either fuel.

Fuel additives approved in the base AFM, POH, or placards continue to be approved in dosage amounts as listed in the AFM, POH, or placards.

Document No. 06-6590007, Revision IR

G100UL® Avgas

FAA Approved Airplane Flight Manual Supplement

This Supplement must be attached to the Airplane Flight Manual or Pilot Operating Handbook when General Aviation Modifications, Inc. G100UL fuel is to be used in accordance with the following SICs: SA01967WI for airframes and SE01966WI for engines.

The information contained herein supplements the information of the Airplane Flight Manual or Pilot Operating Handbook or operating placards only in those areas listed herein. For limitations, procedures, and performance information not contained in this supplement, consult the basic Airplane Flight Manual or Pilot Operating Handbook or appropriate placards.

Digitally signed by KENT S LUND
Date: 2021.07.12 13:25:32 -0500

Kent S. Lund
Manager, Central Flight Test Section, AIR-714
Federal Aviation Administration Wichita, KS

Date: 12 July 2021

FAA Approved Airplane FMS

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Page 2 of 6

FAA Approved 12 July 2021

06-6590007, Rev. IR

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FAA Approved 12 July 2021

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Page 1 of 6

FAA Approved 12 July 2021

Placards

Adjacent to each fuel filler opening, at least one (or more) of the following placards should be added in addition to existing placards describing 100LL or other approved aviation gasoline:



Or



And/Or



Other shapes and sizes of placards for this purpose as may be approved from time to time by the holder of the G100UL avgas airframe STC and those alternative placards may be substituted for any of the placards depicted, above. Placard number 2 should be included for aircraft that have similar existing placards restricting depth of insertion of the fuel nozzle.

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FAA Approved 12 July 2021

SECTION 3 – EMERGENCY PROCEDURES

No Change

SECTION 4 – NORMAL PROCEDURES

During preflight inspection of the aircraft, drain fuel sumps and check fuel for signs of water or contaminants in the usual manner. The native color of G100UL avgas tends to be yellow to dark amber. Mixed 50/50 with 100LL, it will typically have a green tint. Other combinations of 100LL and G100UL avgas will result in still different colors. The color has no effect on the performance of the fuel. Water will still gather at the bottom of the fuel sump's cap, as with 100LL and other aviation gasolines. Observe normal good practices to avoid contact with the skin or excessive inhalation of gasoline vapors. Use soap and water to promptly wash skin areas contaminated with aviation gasolines as soon as possible after exposure.

Operating procedures, including power settings, fuel flow, operating temperatures, operating limitations, etc. as listed in the aircraft POH, FMS, or placards remain unchanged while operating on G100UL avgas.

G100UL avgas has a volumetric energy density that is approximately 1 - 2% greater than that of typical ASTM D810 100LL fuel. Therefore, operation on 100% G100UL fuel may allow running on very slightly lower fuel flow (measured in gallons/hour) while providing the same power. Thus, operation with G100UL avgas may result in negligible to very slightly greater range at the same airspeed compared to operation on the same volume quantity of 100LL avgas, assuming all other factors that have an effect on range are the same.

SECTION 5 – PERFORMANCE

Performance will be essentially unchanged by the use of G100UL avgas, alone, or in any combination with other fuels approved for your airframe and engine.

SECTION 6 – WEIGHT AND BALANCE

The empty weight may change by a slight amount when G100UL avgas is used. This is due only to the very small change in the weight of the unusable fuel which is considered part of the empty weight of the aircraft. The weight of the unusable fuel will increase by ~4% when G100UL is used in place of 100LL. This slight increase in empty weight is considered negligible and does not require the empty weight or c.g. to be re-calculated. The full fuel payload will be reduced by the slight increase in the weight of the volume of G100UL that replaces 100LL in the tanks.

When using Grade G100UL avgas, use 6.25 lbs/gal for weight and balance calculations. For Grade 100LL, use 6.0 lbs/gal for weight and balance calculations. For mixtures of G100UL avgas

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FAA Approved 12 July 2021

and other fuels, either use 6.25 lbs/gal or calculate the weight of the combined fuel types, as indicated by their respective weights/gallon. Note, approved automotive / MoGas may often weigh as much as 6.3 lbs/gallon.

Really simple! Six Pages

06-6590007, Rev. IR

Page 6 of 6

FAA Approved 12 July 2021

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THAT CONTAINS ETHANOL OR METHANOL.**

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When mixed with 100LL avgas the G100UL avgas may change the color of the fuel mixture to a color that does not match the color of either fuel.

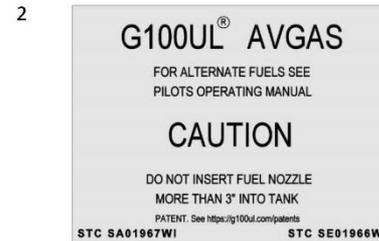
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and other fuels, either use 6.25 lbs/gal or calculate the weight of the combined fuel types, as indicated by their respective weights/gallon. Note, approved automotive / MoGas may often weigh as much as 6.3 lbs/gallon.

Test Plan G100UL & xG100UL Unleaded Avgas Engine Run Detonation Test Plan

----- END -----

Continental Motors Inc. Models: [Excerpt]
 IO-520-B,-BA,-BB normally aspirated and turbonormalized per STC SE5222NM E5CE
 IO-550-B, normally aspirated and turbonormalized per STC SE5222NM
 IO-550-N, normally aspirated and turbonormalized per STC SE10589SC E3SO
TSIO-550-A, TSIO-550-B & TSIO-550-K E5SO

IO-390-A1A6, -A3B6, -A1B6, -A3A6, both normally aspirated and turbonormalized per
 STC SE4082NM
 AEIO-390-A1A6, A3A6, -A1B6, -A3B6 [Excerpt] E00006NY

O-540-B1B5, O-540-B2B5, O-540-B4B5, O-540-J3A5D E-295
IO-540-K1A5D, IO-540-K1G5D, IO-540-K1G5 1E4
TIO-540-AE2A, TIO-540-AH1A, TIO-540-S1AD, TIO-540-J2B, TIO-540-J2BD E14EA

| STATEMENT OF COMPLIANCE WITH AIRWORTHINESS STANDARDS | | DATE |
|------------------------------------------------------|---------------|---------------|
| APPROVED (SIGNATURE) (PRINTED NAME) | | March 7, 2021 |
| 1. Issue | 2. Model | 3. Title |
| 4. Issue Date | 5. Issue Date | 6. Issue Date |
| 7. Description | | |
| 8. Remarks | | |
| 9. Remarks | | |
| 10. Remarks | | |
| 11. Remarks | | |
| 12. Remarks | | |
| 13. Remarks | | |
| 14. Remarks | | |
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| 46. Remarks | | |
| 47. Remarks | | |
| 48. Remarks | | |
| 49. Remarks | | |
| 50. Remarks | | |

The FAA approved the detonation testing on a selection of the most detonation “challenged” engines in the fleet. 11

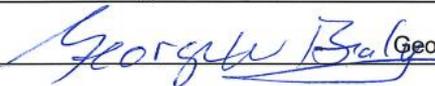
8. PURPOSE OF DATA To define Part 33 detonation tests in support of STC approval of General Aviation Modifications, Inc. G100UL fuel in various engines. FAA Project Numbers ST06669WI-E (was ST13515AT-E) and ST06671WI-E. Covers Test Day Redlines from Oct 1, 2020 REV L approved test plan.

9. APPLICABLE REQUIREMENTS (List specific sections)
 14 CFR Part 33 – Subpart D §33.47 Detonation Test, Amendment None

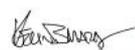
10. CERTIFICATION - Under authority vested by direction of the Administrator and in accordance with conditions and limitations of appointment under 14 CFR Part 183, data listed above and on attached sheets numbered n/a have been examined in accordance with established procedures and found to comply with applicable requirements of the Airworthiness Standards listed.

Recommend approval of these data
 Approve these data

I (We) Therefore

| 11. SIGNATURE(S) OF DESIGNATED ENGINEERING REPRESENTATIVE(S) | 12. DESIGNATION NUMBERS(S) | 13. CLASSIFICATION(S) |
|-------------------------------------------------------------------------------------------------------|----------------------------|-------------------------------------------------------|
|  George W. Braly | DERT-830960-SW | Engines, Powerplant, Flight Test, Flight Test Analyst |

THE FAA WICHITA ACO BRANCH
 ACKNOWLEDGES RECEIPT AND
 CONCURS WITH THE RECOMMENDATION

Name/Date:  Digitally signed by Kevin Bruce Marks
 Date: 2021.03.26 11:22:09 -05'00'

FAA Form 8110-3 (03/10) SUPERSEDES PREVIOUS EDITION



Mark Orr
K.C. Aircraft
Certification Office
"Fuels Engineer"

Kevin Brane (AIR-21)
Fuel Directorate
(Atlanta Office)

Jurgen Priester
Ft. Worth Aircraft
Certification Office
Project Engineer.

Pete Rouse
Air-21. Kansas City ACO.

Fuel being heated and then
pumped into the pre-
heated wing tanks, prior to
each flight.

(105 °F day)
**GAMI SUCCESSFULLY
FINISHED ALL OF THE
REQUIRED FAA PART 23
AIRFRAME FLIGHT
TESTING TO QUALIFY
G100UL UNLEADED
AVGAS FOR A HIGH
COMPRESSION TURBO-
CHARGED AIRCRAFT.**

**To the best of our knowledge, that
was the first time that had ever been
successfully accomplished on an
unleaded aviation gasoline.
It may still be the only time.**

Note: *September 5, 2012*

***There were 4 highly experienced FAA engineers present
to supervise this approved test. Two from Kansas City
and one each from Ft. Worth & Atlanta.***

| U.S. DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION STATEMENT OF COMPLIANCE WITH AIRWORTHINESS STANDARDS | | | | 1. DATE July 3, 2012 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------------------------------------------------------------------------|--------------------------------------|-------------------------|
| AIRCRAFT OR AIRCRAFT COMPONENT IDENTIFICATION | | | | |
| 2. MAKE | 3. MODEL NO. | 4. TYPE (Aircraft, Engine, Propeller, etc.) | 5. NAME OF APPLICANT | |
| Listed below | Listed below | Engine | General Aviation Modifications, Inc. | |
| LIST OF DATA | | | | |
| 6. IDENTIFICATION | 7. TITLE | | | |
| 06-6570010, Rev. D dated June 25, 2012 | G100UL Dynamic Fuel Test | | | |
| Note: This recommend approval is for 14 CFR Part 33 portion of G100UL fuel project, ref FAA Project Number ST13515AT-E. The 14 CFR Part 23 portion of this test plan (ref FAA Project Number ST05845C-A) is recommended for approval on a separate 8110-3. | | | | |
| END | | | | |
| 8. PURPOSE OF DATA - To define dynamic testing of engine components for STC approval of General Aviation Modifications, Inc. G100UL fuel in engines listed above. FAA Project Number ST13515AT-E. | | | | |
| 9. APPLICABLE REQUIREMENTS (List specific sections) | | | | |
| 14 CFR Part 33 §33.15 Materials §33.19 Durability §33.53 Engine System and Component Tests | | | | |
| <p style="text-align: center;">The FAA Central Regional Atlanta Aircraft Certification Office Administrator Request and</p> <p style="text-align: center;"><input checked="" type="checkbox"/> approve approval <input checked="" type="checkbox"/> approve recommendation <input type="checkbox"/> approve data</p> <p style="text-align: center;"><i>DERT-630960-SW 7/3/12</i> <i>AGE-1182 7/3/12</i></p> | | | | |
| 10. CERTIFICATION - Under authority vested by direction of the Administrator and in accordance with Part 155, data listed above and on attached sheets numbered 01-23, have been examined and found to comply with the applicable requirements of Federal Aviation Regulations listed. | | | | |
| <input checked="" type="checkbox"/> Recommended approval of these data. <input type="checkbox"/> Approve these data. | | | | |
| 11. SIGNATURE(S) OF CERTIFYING ENGINEERING REPRESENTATIVE(S) | | | | |
| <i>George W. Braly</i> George W. Braly | | DERT-630960-SW Engine, Powerplant, Flight Test, Flight Test Analyst | | |
| FAA Form 8110-3 (01/10) SUPERSEDES PREVIOUS EDITION | | | | |

| U.S. DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION STATEMENT OF COMPLIANCE WITH AIRWORTHINESS STANDARDS | | | | 1. DATE May 7, 2015 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------------------------------------------------------------|--------------------------------------|------------------------|
| AIRCRAFT OR AIRCRAFT COMPONENT IDENTIFICATION | | | | |
| 2. MAKE | 3. MODEL NO. | 4. TYPE (Aircraft, Engine, Propeller, etc.) | 5. NAME OF APPLICANT | |
| Listed below | Listed below | Aircraft/Engine | General Aviation Modifications, Inc. | |
| LIST OF DATA | | | | |
| 6. IDENTIFICATION | 7. TITLE | | | |
| 06-6570010 Rev. NC dated 06/05/2014 | G100UL Dynamic Fuel Test Results | | | |
| END | | | | |
| 8. PURPOSE OF DATA - To define Part 23 and Part 33 dynamic fuel test results in support of STC approval of General Aviation Modifications, Inc. G100UL fuel in various airframes and engines. FAA Project Numbers ST13515AT-E and ST00091FD-A. | | | | |
| 9. APPLICABLE REQUIREMENTS (List specific sections) | | | | |
| 14 CFR Part 23 §23.963 Fuel Tanks; General §23.993 Fuel System Lines and Fittings §23.1163 Lines Fittings and Components | | | | |
| 14 CFR Part 33 §33.15 Materials §33.19 Durability §33.53 Engine System and Component Tests | | | | |
| 10. CERTIFICATION - Under authority vested by direction of the Administrator and in accordance with conditions and limitations of Supplement under 14 CFR Part 155, data listed above and on attached sheets numbered 01-23, have been examined and found to comply with applicable requirements of Federal Aviation Regulations listed. | | | | |
| <input type="checkbox"/> Recommended approval of these data. <input checked="" type="checkbox"/> Approve these data. | | | | |
| 11. SIGNATURE(S) OF CERTIFYING ENGINEERING REPRESENTATIVE(S) | | | | |
| <i>George W. Braly</i> George W. Braly | | DERT-630960-SW Engine, Powerplant, Flight Test, Flight Test Analyst | | |
| FAA Form 8110-3 (01/10) SUPERSEDES PREVIOUS EDITION | | | | |

FAA Accepted, AIR-21
George W. Braly Date 4/24/16
 With : Report 06-6570016A, Rev. NC dated 1-21-2016, Addendum to G100UL Dynamic Fuel Test Results

These are copies of the formal FAA approvals for :

- 1) Material Compatibility "Dynamic Fuel Test" Test Plan; And
- 2) The successful & fully approved final report demonstrating comprehensive material compatibility with fuel wetted components of the aircraft and engine systems.



G100UL™ High Octane Unleaded Gasoline Fueling the Future of General Aviation



G100UL™
Unleaded Avgas

50/50 Mixture of
G100UL™ Unleaded Avgas
and FBO 100LL

FBO 100LL

FAA STC No. SA01967WI / SE01966WI

Frequently Asked Questions about G100UL™ Avgas:

What changes will I have to make to my engine to use G100UL™ avgas?

Other than placards, no modifications are required. A small placard is attached to the engine and "stick - on" placards are applied to refueling ports. In addition, there is a short POH supplement added to the AFMS.

How much more than 100LL is G100UL™ avgas going to cost? / What will the STC cost?

Current best estimates are that G100UL™ avgas will cost 60 - 85 cents/gallon more than 100LL as the fuel leaves the producer's facility and begins to enter the stream of commerce. Estimates are based on crude oil pricing and will vary with the price of crude oil. The STC pricing will be based on engines and horsepower, in a manner similar to the pricing for other fuel STCs that have been available for low octane gasolines.

How soon can I buy a tank of G100UL™ Avgas at my airport?

As fast as production can be ramped up and delivered to airports, it will be available.

What is the octane performance of G100UL™ avgas?

During FAA approved detonation testing, the detonation protection from use of G100UL™ avgas exceeded that of a corresponding ASTM D910 100LL. That detonation testing was personally observed by highly experienced FAA propulsion engineers.

Other than being lead - free, are there other benefits to G100UL™ avgas?

Spark plug maintenance and replacement intervals will be improved in the absence of metallic deposits from lead. In addition, it is likely that over time oil change intervals will double. Without the lead, it is likely that a synthetic oil will become available and that will further increase oil change intervals and reduce the hassles associated with oil changes. It remains to be seen if TBO recommendations will increase over time.

What are the operating limitations/concerns/exclusions with use of G100UL™ avgas?

They do not change. G100UL™ avgas is basically "transparent" to the engine, aircraft, & pilot.

Will the operation of my engine change with G100UL™ avgas?

No. Pilots with sophisticated engine monitors may be able to detect small, negligible, changes in EGTs compared to operation on 100LL.

Are there any airspeed or range implications with the use of G100UL™ avgas?

Essentially, no. At the same volumetric (GPH) fuel flow and a LOP mixture, the aircraft will be one or maybe two knots faster, due to the slightly higher volumetric energy density. Likewise, with full tanks, the range of the aircraft will be the same or possibly increase by ~ 1%. However, G100UL™ avgas weighs about 6.3 lbs/gallon, rather than ~ 6.0 lbs/gallon.

Can I mix G100UL™ avgas with 100LL (or mogas)?

Yes. Co - mingling of G100UL™ Avgas and other gasolines approved for use in your aircraft is specifically authorized in the limitations section of the STCs, and will be functionally transparent to the engine and pilot.

Which Engines & Airframes are covered with the initial STC?

According to a carefully planned agreement with the FAA, a small number of Lycoming engines and Cessna airframes were selected for the initial Approved Model List. That list is designed as a "place holder" list for a much larger spectrum of Lycoming and Continental engines that will be added as the AML expands over the next nine to twelve months.



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Ada, Oklahoma 888-359-4264
www.gami.com



Avfuel
Ann Arbor, Michigan
www.avfuel.com



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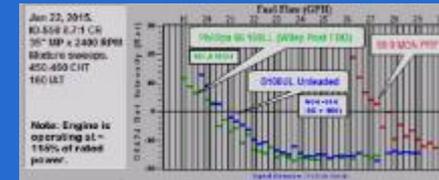


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Why did GAMI elect to not participate in the PAFI project ?



1) We asked some questions and were advised:

- A) That once GAMI submitted a fuel formulation to PAFI, that GAMI would not be allowed to make any refinements or tweak that formulation. (That was a “non-starter.”)
- B) Further , we were already a long way down the certification path towards a functional fleet wide AML STC AND WE WERE ADVISED THAT WE WOULD GET NO CREDIT FOR THAT EXTENSIVE PREVIOUS CERTIFICATION WORK.

Items A & B were “deal killers” for any possible GAMI participation in the PAFI project.



Why? Because THAT PROCESS is NOT how successful real world Research & Development is actually conducted.

4 years later - - the FAA changed that policy!

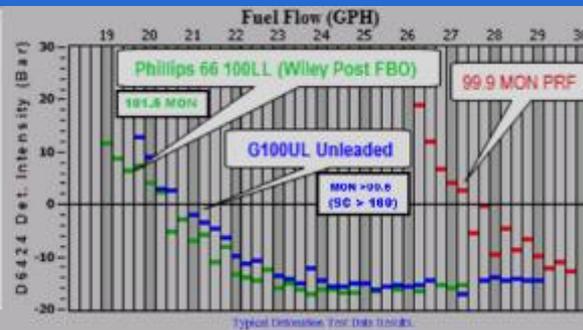


We remain convinced that we made the right choice to stay out of the PAFI project and to pursue our AML / STC.



Jan 22, 2015.
IO-550 8.7:1 CR
35" MP x 2400 RPM
Mixture sweeps.
450-460 CHT
160 IAT

Note: Engine is operating at ~ 115% of rated power.



The balance of this presentation provides a “window” into the unleaded fuel certification activities we have been pursuing with the help of the FAA.



After 14 months of effort, in 2015, GAMI obtained FAA approval of a formal “Issue Paper” that established GAMI’s means and methods for conducting detonation testing to be fully approved by the Administrator.

This 34 page “issue paper” formally “blesses” a well defined, objectively determinable, detonation test and intensity measurement method and pass / fail requirements for use in certifying new fuels for the fleet.

ISSUE PAPER

PROJECT: General Aviation Modifications, Inc. (GAMI) STC Project Number ST15151A1-E for use of GAMI G100LL fuel on Model CMT10 190 N Turbo-normalized engines
ITEM: P-1
STAGE: 1

REG. REF.: 14CFR Part 33.47
DATE: November 9, 2015

NATIONAL POLICY REF.: FAA AC 33.47-1
ISSUE STATUS: Closed

SUBJECT: STC ST15151A1-E Method of Compliance for determination of landing detonation performance to 14 CFR 33.47
BRANCH ACTION: AM-21, ANE-111
COMPLIANCE TARGET: Prior to STC

Method of Compliance

STATEMENT OF ISSUE:

General Aviation Modifications, Inc. (GAMI) (the Applicant) has applied for an Approved Model List (AML) Supplemental Type Certificate (STC) Project Number ST15151A1-E to add their U190LL turbocharged aviation engine to the list of approved fuels for use on the Teledyne Continental Motors (TCM) IO-560-N engines installed in Cirrus SR22 airplanes that are modified with the Toronado Alky Turbo (TAT), Inc. turbo-normalizing system STC.

Regulation § 33.70(b)(2) requires, in part, that for reciprocating engines, the FAA Administrator establish engine operating limitations related to fuel grade or specification.

The applicant defines proposed limitations under § 33.70(b)(2) for the type certified engine. The Administrator may approve the proposed limitations based on the Applicant's showing of compliance design, test and analysis data. The approved fuel grade or specification limitation must also be listed in the airplane flight manual (AFM) or an airplane flight manual supplement (AFMS) for an STC as a limitation for the engine model and airplane model. Only fuel grades or specifications specifically identified in those documents are permissible for operation.

The applicant has proposed that the FAA accept their fuel specification, in combination with appropriate engine 14CFR Part 33 testing, including compliance check engine tests to 14 CFR 33.47. The time to be determined is the method of compliance associated with 14 CFR 33.47, Amendment 39, “each engine must be tested to establish that the engine can fraction-reduce detonation throughout its range of intended conditions of operation.” An acceptable method of compliance is provided in AC 33.47-1 and multiple Design Approved Holders (DAHs) have:

This was the first time the FAA had ever “blessed” a detonation test methodology (and “pass/fail” criteria) by the rigorous “Issue Paper” process.

GAMI STC Project No ST15151A1-E for use of GAMI G100LL fuel on various reciprocating engines

STAGE: 1
 DATE: November 9, 2015
 PAGE: 11

ISSUE PAPER Request No: ST15151A1-E for use of GAMI G100LL fuel on various reciprocating engines

STAGE: 1
 DATE: November 9, 2015
 PAGE: 11

DO NOT REMOVE FROM A TECHNICAL ISSUE PAPER

ISSUE PAPER SUBMITTAL FORM

PROJECT: ST15151A1-E General Aviation Modifications, Inc.

ITEM: P-1
 STAGE: 1
 DATE: November 9, 2015

SUBJECT: STC ST15151A1-E Method of Compliance for determination of landing detonation performance to 14 CFR 33.47

PROJECT MANAGER: Kevin Ryan 100-111

| STAFF LISTINGS | | |
|--------------------------------|------------|----------|
| Branch: | STC | |
| Name: | Kevin Ryan | |
| Initials: | KJR | |
| Date: | 11/09/15 | |
| APPROVALS | | |
| Checked: | Kevin Ryan | 11/09/15 |
| Name: | Kevin Ryan | 11/09/15 |
| Initials: | KJR | |
| Date: | 11/09/15 | |
| SUPERVISOR AND QUALITY CONTROL | | |
| Checked: | Kevin Ryan | 11/09/15 |
| Name: | Kevin Ryan | 11/09/15 |
| Initials: | KJR | KJR |
| Date: | 11/09/15 | |
| SUPERVISOR/STATE MANAGER | | |
| Checked: | Kevin Ryan | 11/09/15 |
| Name: | Kevin Ryan | 11/09/15 |
| Initials: | KJR | |
| Date: | 11/09/15 | |

Summary: GAMI, with active FAA participation and approved test plans and approved test results, has successfully completed:

- 1) **Material compatibility;**
- 2) **High altitude operation, high altitude re-start;**
- 3) **Hot day / hot fuel climb and operational testing;**
- 4) **Performance testing;**
- 5) **150 hour 14CFR Part 33 engine “block” test on aircraft.**
- 6) **170 hour on-aircraft “real world” F & R (functionality and reliability) testing.**
- 7) **Update: December 15 & 16, 2020, 14CFR33.47 detonation testing successfully completed.**

ALL of these tests - - and the resulting data - - have now been fully approved by the FAA.



GAMI has two remaining FAA tests we mutually agreed were prudent to complete the G100UL avgas project for a:

Functional “Fleet Wide” - - ALL AIRCRAFT / ALL ENGINES STC approval for G100UL.

These are tests that are closely similar to tests that GAMI has already successfully performed as certification tests or “company tests”. For this reason, GAMI believes the risk of failure is extremely low.



What is GAMI's plan for deploying G100UL into the field?



Fleet Wide – All Aircraft & All Engine FAA Certification

1) Patents , FAA Certification, and Quality Control.



2) Chemistry, Patents & Critical Production of Octane Enhancer.

~ 160-200 million gallons/year of 100 octane unleaded avgas - - delivered to the aircraft.



3) Production of 100+ million gallons / year of high quality aviation alkylate used in GAMI's G100UL unleaded Avgas.



This entity is identified and committed to this project.

4) Avfuel will supervise the logistics of production and delivery of G100UL unleaded avgas to FBO's in order to get G100UL into the wings of the entire fleet of G.A. Aircraft.

In the next few slides, there is further information about the practical aspects and impact that a high octane unleaded avgas will have for the general aviation fleet of spark ignition piston engines.

Cylinder # 1.
Exquisitely clean
after ~170 hours
flight test
with G100UL.

Cylinder from 150
hour durability test.

Dramatic difference compared to
cylinders operated on 100LL.

Operators of high performance air cooled piston race engines are able to extend the time between overhaul substantially when operating on unleaded fuel, as compared to their experience operating on leaded gasoline.

Without the lead, and using synthetic engine oil, there will be greatly extended (2 – 3 X) intervals for oil changes, which are a major ongoing expense and a nuisance for pilots.

We anticipate, ultimately, the fleet will be able to achieve extensions for TBO* by 25% or more by eliminating the metallic lead deposits from the engine.

That saves the owner about \$8-9K at each overhaul.





Cylinder # 1.
Exquisitly clean
after ~170 hours
flight test
with G100UL.

Dramatic difference compared to
cylinders operated on 100LL.

Without the metallic lead deposits - - the engines may be operated on synthetic motor oils.

Our previous testing shows that synthetic aviation oils reduce friction in aircraft piston engines sufficiently to lower the operating cylinder head temperatures by 15 to 25 degrees F. That is a significant improvement and allows for extended life and potentially slightly higher speeds due to reduced cooling drag.



Problems - - G100UL™ DOES NOT HAVE:

- 1) *Lead or other metallic deposits in the combustion chambers.
Flight test engine remarkably free of deposits after operation on 100LL for 473 hours and then 170 hours of “clean up” with G100UL.*
- 2) *Incompatibility (fungibility) with 100LL.*
- 3) *Cold weather starting and operational problems.
(Adequate vapor pressure and adequate v/v % of low boiling point components to assure cold starting performance on par with 100LL)*
- 4) *Long term storage issues. Demonstrated 3.5 year duration real world hot & humid weather storage (Florida) w/ no gum or other adverse changes in fuel.*

. . . More:



Problems - - **G100UL™** DOES NOT HAVE:

5) **Unapproved test methods. GAMI IS THE ONLY entity that has an FAA approved (signed off on by Air-21) **DETONATION TEST METHOD ISSUE PAPER and PASS/FAIL CRITERIA** that is:**

Free of biases and otherwise verified (by back to back comparison testing) to be traceable to the detonation intensity test levels used for the original certification of almost all of the current general aviation spark ignition piston engines.



Problems - - G100UL™ DOES NOT HAVE:

6) Supercharge rating.

The ASTM spec is 130 for 100LL for the ASTM D909 supercharge rating. For the old “purple” gas, it was 145. (As in 115/145).



DIXIE SERVICES INCORPORATED

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1706 FIRST STREET

GALENA PARK, TEXAS 77547
www.dixieservices.com

VOICE 713 672 1619
FACSIMILE 713 672 1634

CERTIFICATE OF ANALYSIS

Number: 137800

Client: FAA WJH Technical Center
Propulsion and Fuel Systems Team, AJP-6340
Atlantic City International Airport, NJ 08405

Date: May 25, 2011

Attention: Dave Atwood

**From a G100UL test
sample prepared at the
AFETF and sent for
analysis by the FAA.**

Sample: CTG 100UL, submitted 09 May 11
Marks: B3 MT5
Date: 25 Apr 11

| | | |
|-------|---------------------------------------------|--------|
| D2699 | Research octane number (BRE/30.0in/126F) | 110 |
| D2700 | Motor octane number (BRE/30.0in/300F) | 101.2 |
| D4809 | Net heat of combustion, Btu/lb | 18,212 |
| D909 | ASTM Supercharge rating, mL TEL/gal | * |

* It was not possible to acquire a standard D909 Supercharge rating for this sample because its knock-limited power curve did not follow the response typical of the leaded primary reference fuels. (See attached graph of power curves). However, the peak power obtained for this sample was approximately equivalent to that of the iso-octane + 6.00 mL TEL reference fuel, which has an assigned performance number of 161.0.

The G100UL supercharge rating is extremely high. Typically 150-160+. This supercharge rating is of great significance to the Warbird community.

Using G100UL, all of those engines that were de-rated when 115/145 ceased production will again be able to operate at their full military power ratings.



GAMI's aircraft piston engine test stand control room.



“Expansion of the AML to:

~ ALL AIRCRAFT / ALL ENGINES

AML STC approval for G100UL™ avgas - - -

when ?

Based on the progress made over the last 11 months with our new FAA Team . . .

Q1 to Q2 2022.



Questions ?

Leave no engine on the ground . . .

