

	<b>Topics</b>	<b>Questions about G100UL™ avgas</b>	<b>Answers</b>
<b>G100UL avgas vs 100LL</b>			
<b>The three questions most often asked:</b>			
<b>1</b>		<b>What changes will I have to make to my engine to use G100UL avgas?</b>	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 AFMS supplement added to the AFM or POH.
<b>2</b>		<b>How much more than 100LL is G100UL avgas going to cost?</b>	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 at 40-60 dollars/barrel, and will vary with the price of crude oil.
<b>3</b>		<b>How soon can I buy a tank of G100UL avgas at my airport ?</b>	As fast as production can be ramped up. That will not happen “over-night”. See the answers to questions 13 & 14, below, for more information on how the progressive rollout of G100UL avgas is likely to take place.
<b>Other questions asked about G100UL avgas:</b>			
<b>4</b>		<b>What is the octane of G100UL avgas?</b>	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.
<b>5</b>		<b>Other than being lead-free, are there other benefits to G100UL avgas ?</b>	<p>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.</p> <p>Operators of air-cooled race car engines have reported substantial improvements in the TBO of those high performance engines after changing from leaded to unleaded gasoline. It remains to be seen if that may also apply to air-cooled piston aircraft engines.</p>
<b>6</b>		<b>What are the operating limitations/concerns/exclusions with use of G100UL avgas?</b>	They do not change. G100UL avgas is basically “transparent” to the engine, aircraft, & pilot.

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7		<b>Will the operation of my engine change with G100UL avgas?</b>	No. Pilots with sophisticated engine monitors may be able to detect small, negligible, changes in EGTs compared to operation on 100LL.
8		<b>Are there any airspeed or range implications with the use of G100UL avgas?</b>	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.
9		<b>What is the color of G100UL avgas?</b>	Typically, it has an orange or amber color. When mixed 50/50 with blue 100LL the color is green, and similar to the color of earlier 100/130 “green” avgas.
10		<b>My airplane has a MoGas STC. Can I mix G100UL avgas with MoGas?</b>	Yes. Comingling of G00UL Avgas and other gasolines approved for use in your aircraft is specifically authorized in the limitations section of the STCs.
11		<b>Over the past three or four years, I have heard rumors about problems with other candidate unleaded fuels. Those problems are purported to include cold weather starting problems, paint stripping from spillage at the filler for the gas tank, and metal additives that fouls spark plugs. Has GAMI addressed and avoided all of those issues?</b>	<p>Yes. An FAA test pilot conducted successful cold weather operational starting and flight-testing with no difficulties.</p> <p>The “paint stripping” you have heard about was unique to some particular components in that candidate PAFI fuel formulation. G100UL avgas has demonstrated no evidence of causing any degradation of paint on aircraft surfaces.</p> <p>Further, at GAMI’s request, ERAU, as a 3<sup>rd</sup> party, completed a highly successful 150 hour engine durability test conducted on an engine that already had 400+ hours of operation on 100LL. The post-test engine teardown demonstrated the engine and combustion chambers were noticeably cleaner at the end of that 150 hours operating on G100UL avgas than before the test started. That testing at ERAU was closely monitored by the FAA with personnel out of the Atlanta Aircraft Certification Office.</p>
12		<b>Are there any known material compatibility issues in aircraft, engines, storage tanks or transportation systems?</b>	After extensive testing, no compatibility issues have been identified in any aircraft, engines, storage tanks or transportation systems. G100UL is a drop-in fuel, fully fungible with 100LL and other aviation gasolines, and ready to be used within the industry’s existing infrastructure.

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	<b>AML STC</b>		
<b>13</b>		<b>What is an “AML” STC?</b>	An “Approved Model List” STC is a well-established FAA method to provide an orderly process for the expansion of the applicable make & models of aircraft and engines to any modification of the original aircraft or engine. Typically, the initial AML STC is issued with only one or a few make & model aircraft or engines in the “AML” list attached to the STC. Thereafter, based on additional review of data, further makes and models are added to the attached “AML” list.
<b>14</b>		<b>Which Engines &amp; Airframes are covered with the initial STC?</b>	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.
<b>15</b>		<b>Why were those particular airframes and engines selected to be on the initial “Approved Model List”</b>	<p>Those particular makes and models were selected for several reasons. Importantly, those models encompass a group of engines and aircraft that are commonly used at one or more prominent high-volume flight training schools.</p> <p>In 2013-2014, Embry Riddle conducted a very successful 150 hour formal FAA approved and supervised endurance run using G100UL avgas. Embry Riddle has more experience with G100UL avgas than any other entity outside of GAMI. (Later, Embry-Riddle also conducted unleaded avgas testing for several PAFI candidate fuels.)</p> <p>GAMI and Embry Riddle are exploring the dedication of the initial production of G100UL avgas to that flight school, until much larger volume production comes “on-line”.</p>

<p style="text-align: center;">16</p>		<p><b>The following are a group of four questions for which the answers are closely related::</b></p> <p><b>A) What additional testing is planned / necessary?</b></p> <p><b>B) When will the list of approved aircraft and engines be expanded to include the highest performance general aviation aircraft and engines?</b></p> <p><b>C) When will there be a “Fleet Wide” approval?</b></p> <p><b>D) Will any aircraft / engines be excluded?</b></p>	<p>The technically difficult and critical portions of the G100UL avgas certification tasks required for a functional “fleet wide” expansion of the approved model list are all completed and formally accepted by the FAA.</p> <p>That testing included hot day/hot fuel flight-testing of a high compression turbocharged aircraft to 25,000 feet, a 150-hour endurance test, and <i>extensive</i> material compatibility testing, and an exhaustive set of detonation tests, as described below.</p> <p>The critical 14 CFR 33.37 detonation testing necessary to cover all of the high horsepower / high compression ratio/ turbocharged engines has already been successfully completed and approved by the FAA (March 7, 2021).</p> <p>Complete Part 23 flight-testing for both a Lycoming powered aircraft and a Continental powered aircraft have been completed and approved by the FAA. A complete 14 CFR 33.49 FAA certification “endurance” test has been successfully completed on a Lycoming engine.</p> <p>The FAA has asked GAMI to conduct two further tests, both of which are now underway. These are routine tests that GAMI has successfully conducted on several previous STC projects. Completion of those two tests will complete all of the testing required to support a dramatically expanded Approved Model List.</p> <p>At this time, GAMI is unable to identify any general aviation spark ignition piston powered aircraft or engine that does not fall within the scope of the planned expansion of the Approved Model List. The scope of that expansion plan has already been coordinated with the FAA and is part of the approved certification planning documents.</p> <p>Ultimately, a greatly expanded AML list of aircraft and engines will be the “surrogate” for what is commonly referred to as a functional fleet-wide approval. That expansion of the AML is planned to occur within the next few calendar quarters.</p> <p>GAMI does not anticipate that any piston powered aircraft or engines that are generally considered to be part of the general aviation fleet will be excluded.</p>
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17		<b>What will the STC cost?</b>	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.
18		<b>What is included in the STC paperwork?</b>	A very short Approved Flight Manual Supplement (AFMS) and placards to be installed around the fuel filler ports on the aircraft and one on each engine. There is a short set of routine I.C.A's (Instructions for Continued Airworthiness) and Installation Instructions for the placards. The same as any other normal STC.
19		<b>Will G100UL avgas work on the Warbirds at full rated power?</b>	<p>The detonation testing data fully supports that application. The standard ASTM detonation test for operation at full take-off power (D909) demonstrates that G100UL is superior even to the old 115/145 "Purple" avgas used on DC-7's and Constellations.</p> <p>GAMI anticipates G100UL avgas will be adopted for "Warbird" operation under the same limitations, if any, as are appropriate for operation with 100LL.</p> <p>However, detonation testing and laboratory data supports a "full rated power" application.</p> <p>The standard ASTM detonation test for operation at full take-off power and rich mixture (D909) demonstrates G100UL is superior even to the old 115/145 "Purple" avgas used on DC-7s and Constellations.</p>
<b>Testing and Approval</b>			
20		<b>Is G100UL avgas approved by the FAA?</b>	The initial STCs with the initial Approved Model Lists have been signed and approved by the FAA. There is one STC for an initial group of aircraft and a separate STC for their corresponding engines.
21		<b>Did any FAA personnel travel to GAMI's facility in Ada, Oklahoma and directly observe / witness/ supervise the testing of G100UL avgas?</b>	
		<b>Answer:</b> At various times, different combinations of twelve (12) senior FAA engineers and program managers traveled to Ada, Oklahoma (and other locations) - - and personally observed flight testing, engine durability testing, post-test engine tear down inspections, material compatibility testing, flight testing, and "back to back" comparison engine detonation testing of G100UL avgas and 100LL. In addition, there was a further group of ten or more senior FAA certification personnel who were involved in the G100UL avgas approval process.	

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22		<b>Were there any new or novel discoveries or innovations that led to the successful approval of G100UL avgas?</b>	<p>Yes. There were several “break-through” discoveries in the 2012-2014 timeframe.</p> <p>In the fall of 2015, after an extensive, year-long internal technical review, the results and applicability of two of those discoveries to the certification of engines for operation on unleaded aviation gasoline were formally approved by the FAA in a formal G100UL project “Issue Paper”. This process is the most rigorous review process used by the FAA for any certification activity.</p>
23		<b>Did GAMI engage any subject matter experts to assist with the technical issues that were identified during the development of G100UL avgas?</b>	<p>Yes. GAMI has had extensive technical support from one of the world’s premier specialty chemical companies, which provided substantial technical assistance with the development of the test protocols for assuring the production quality control of G100UL. In addition, at various times, GAMI sought out and obtained technical assistance by three former refining industry employees with specific, long term, experience in relevant areas.</p>
24		<b>What specific tests were conducted?</b>	<p>The list of tests conducted is comprehensive and extensive. Among those:</p> <p>Material compatibility testing was identified as an early go/no-go requirement that took nearly a year to complete.</p> <p>Hot day, hot fuel, high-altitude and engine restart tests were completed early in the process.</p> <p>Early “screening” detonation testing successfully completed, as another go/no go “check-box.” Later, there was an exhaustive series of detonation tests conducted, as noted below.</p>

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25		<b>Detonation testing has always been the main problem. Were the detonation test plans and the testing approved by the FAA?</b>	<p>Yes. The detonation test “means and methods” were intensely scrutinized and reviewed by the FAA. As far as GAMI is aware, GAMI now has the only modern, internal cylinder pressure sensor based aircraft engine detonation test methodology that is specifically approved by the FAA through its highest level of oversight, documented through the formal FAA “Issue Paper” process.</p> <p>Note: GAMI and its “sister” company Tornado Alley Turbo, Inc. have previously conducted numerous, successful, FAA approved detonation certification tests on several critical turbo-charged piston aircraft engine applications with several millions of hours of successful field experience.</p>
26		<b>Was the FAA present on site (in spite of COVID) to observe the Detonation Testing?</b>	<p>Yes. The FAA spent the better part of two days in the GAMI test cell in Ada, during that detonation testing. Other FAA personnel simultaneously observed the engine runs remotely through zoom links to the four test stand computer screens.</p>
27		<b>What was the compression ratio, Manifold Pressure and the highest horsepower achieved during detonation testing that successfully passed a formal FAA 14 CFR Part 33.47 Detonation test?</b>	<p>At the conclusion of the two days of detonation testing, GAMI elected to complete an optional test item from the FAA approved test matrix.</p> <p>That test item was to determine the maximum Brake Horsepower (BHP) at which the 8.7:1 CR IO-550 turbo-charged test engine could be operated and continue to pass a standard Part 33.47 FAA full power detonation test. With redline cylinder and induction air temperatures, the engine easily operated at 41.4” MP, 380 actual BHP (414 BHP when corrected to Standard Day conditions). We were unable to determine how much more additional HP could be obtained because the pressure relief “pop-off” valve on the induction system was limiting further increases in manifold pressure.</p>
28		<b>GAMI started this project over 10 years ago. Why has it taken so long to get G100UL avgas approved by the FAA?</b>	<p>There was a lot of new and novel fundamental Research and Development that was required. There were some inevitable changes in FAA personnel over that time-period that slowed the progress. In addition, GAMI funded all of the entire R &amp; D effort from business cash flow.</p>

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29		<b>Were aircraft and engine original equipment manufacturers (OEMs) involved in the development of G100UL avgas?</b>	<p>Early in the development of G100UL avgas both Lycoming and Continental sent engineers to GAMI in Ada who evaluated G100UL avgas and flew a turbocharged Cirrus operating on G100UL avgas in one wing tank and 100LL in the other. There was no objection raised by either of those two early OEM engine manufacturers to the performance of the G100UL avgas.</p> <p>In addition, Cirrus Aircraft had one of their senior managers come to Ada. He was an experienced pilot who also flew the G100UL avgas in a Cirrus aircraft to evaluate its performance against 100LL.</p> <p>Cirrus also conducted extensive material compatibility testing of G100UL avgas with their composite fuel tank materials using their FAA approved testing protocols. That was very helpful and timely.</p>
30		<b>Does G100UL avgas have an ASTM specification?</b>	No. GAMI elected to use the existing and approved STC pathway to obtain approval for our general aviation aircraft and engines to use G100UL avgas
31		<b>Why did GAMI elect to pursue the STC certification path rather than join the FAA “Piston Aviation Fuel Initiative” (PAFI) project?</b>	Primarily, because that process began three years after GAMI had started the G100UL avgas STC project and there was no mechanism within the PAFI project for GAMI to obtain “credit” for the substantial certification work, which the FAA had already approved. There were additional reasons.
32		<b>Are there any new toxicity concerns with G100UL compared to 100LL?</b>	The components in this new, high-octane, unleaded avgas have been carefully vetted and no new toxicity issues have been found. A draft Material Safety Data Sheet (MSDS) has been developed in consultation with world-class experts in that field. That new MSDS is similar to and consistent with existing MSDS documents for other transportation gasolines widely used in the marketplace.

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	<b>Distribution and availability</b>		
33		<b>GAMI is a small company. How is GAMI going to create the infrastructure and finance the inventory to produce millions of gallons of G100UL avgas?</b>	GAMI has collaborated with Avfuel Corporation to oversee the logistics of productions and distribution. Avfuel is a global supplier of aviation fuels and services, and currently sells 100LL to more than 650 FBOs.
34		<b>Are there any concerns regarding price or availability given the proprietary formulation of G100UL and competitive nature of high-octane unleaded avgas?</b>	Avfuel and GAMI have put in place specific contractual language that allows any legitimate distributor and supplier of G100UL avgas non-discriminatory pricing and access to all available supplies.  GAMI and Avfuel believe the contract and licensing terms of the G100UL avgas producers, blenders and distributors will result in the elimination of some existing transportation-cost-related market inefficiencies arising out of existing proprietary sourcing and distribution of 100LL.
35		<b>What airports will be the first to have G100UL avgas?</b>	Most likely, the first airport to have G100UL avgas will be co-located with one of the large flight training schools.
36		<b>How long will it take in order for G100UL to be widely or routinely available?</b>	As rapidly as the supply chain and associated infrastructure can be put in place.  GAMI and Avfuel anticipate that the availability of G100UL will expand nationally over a period of a few years, at a pace determined by eventual depletion of 100LL stocks, the number and location of new producers and blenders, and any mandates by the Federal and local governments
37		<b>Will there be specific FBOs that are unable to get access to supplies of G100UL avgas due to proprietary licensing to certain suppliers and vendors?</b>	No such limitations are expected. Avfuel and GAMI have committed that the logistics and licensing of distribution will ensure that G100UL is fairly accessible and priced.

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<b>38</b>		<b>I fly from airports in Northern California. I am concerned 100LL will be banned before G100UL is widely available. Will there be any priority for airport locations in regions of the Country that have a history of high profile environmental activity?</b>	<p>While that is a concern, it is unlikely that any significant number of municipalities will ban 100LL in the absence of an alternative.</p> <p>Avfuel and GAMI are aware of that potential issue and are actively working to mitigate that possibility.</p>
<b>39</b>		<b>Will multiple high octane avgas fuel alternatives exist in the marketplace?</b>	<p>That outcome is rather unlikely.</p> <p>G100UL avgas is fungible in any proportion with any currently approved aviation gasoline.</p> <p>Because avgas volumes are low relative to jet fuel, and because airport fuel storage tanks have become very expensive to construct and maintain, it is unlikely that any given airport FBO will have multiple unleaded fuels for sale.</p>