G100UL Usage Report

Paul Marshall
Bonanza A36, N4305U, manufactured 2000, s/n E-3305
Airframe 3179.3 hours since new
Engine: 1461 hours since new; Compression Test: #1) 74/80, #2) 70/80, #3)70/80, #4)66/80, #5) 72/80, #6 69/80
Engine elapsed time during G100UL usage period in this report: 67.0 hours
2025 04 02, version 6

Summary:

My 2000 Bonanza A36 just came out of annual and I have decided to stop using G100UL. Between Nov 2 2024 and March 9 2025 we fueled 531 gallons of G100UL into the plane. I have noted several problems during this period and finally decided last week to stop using it. It has stained my paint in multiple places and even started bubbling a small section of paint near a fuel vent. Recently I noticed that I started getting an unexplained hard shiny black substance on my dipstick that would not rub off. Also, I noticed increased friction getting the dipstick and cap on and off the engine. And once I even saw small pink rubbery looking pellets under the dipstick cap when I took it off. Together, these were a large red flag to me, indicating the possibility of degrading rubber in my fuel bladder or resin leaching out of my D'Shannon tip tanks and into the fuel, or possibly partial dissolution of the dipstick cap gasket. This red flag caused me to decide to stop using the fuel. During the annual I took a closer look at the paint damage and that made a stronger impression on me, too, especially where it was bubbling off the metal at a fuel vent under the wing. Related issues during my trial period were a fuel injector that got partially clogged during a flight, where the mechanic who cleaned the injector said that yes, there was some kind of matter in the injector that they removed - Maybe I'm fortunate, but I have not had to deal with a semi clogged injector in flight before. And related to that was an unexplained black substance on my fuel injectors that took unusual measures for the mechanic to remove. During the annual they replaced my left muffler which had been destroyed on the outside due to unexplained reasons perhaps related to excessive heat or a couple of backfires on start. I have replaced a muffler maybe once or twice in 25 years of ownership. My sight gauges on my tip tanks are a little harder to see the gas through, but I am not sure if that is a result of the normal aging process where the sight gauges get more opaque over the years. I dealt with some fuel odor issues in the cabin, but those were resolved satisfactorily. Early on in my use, I was impressed with improved climb performance, reduced fuel burn from 13.3 gph to 13.0 gph. And my two oil changes showed significantly reduced metals wear. The viscosity of the oil was slightly reduced below minimum and below previous averages.

Report Body

Fuel Usage:

I, Paul Marshall, have refueled my plane exclusively with G100UL while in the greater Bay area during the period from November 2, 2024 to March 9, 2025. In that time, I and my partner pumped 531 gallons of G100UL fuel from Reid Hillview and Watsonville airports into the plane,

enough to travel approximately 6700 statute miles with that fuel. While far outside the bay area, (southern California, Mexico) I have refueled locally with 100LL. My travels during this period included 4 round trips from San Martin to El Fuerte, Sinaloa, Mexico, flying staff to and from a free medical clinic in Mexico operated by Liga International, the Flying Doctors of Mercy. These trips constituted about 52 of the 67 flight hours during the use period. Typically I would fly down from San Martin to Burbank and then Puerto Penasco on G100UL, refuel mains only with 100LL, continue on to El Fuerte for the clinic, depart with a short flight to Guaymas where I would fill the tip tanks full and put 70 gallons in the mains (100LL), and then fly on through Calexico and Burbank avoiding refueling until arriving at Watsonville or Reid Hillview, where I refilled the mains with G100UL. That probably represented a duty cycle of two fillups with G100UL in norcal followed by two fill ups in Mexico with 100LL, always operating as some mixture of 100LL and G100UL. The D'Shannon fiberglass tip tanks were filled with G100UL 2 or 3 times during the period. I have been a leading proponent within the local pilot community for adopting unleaded fuels in our aircraft.

Findings:

In my experience with this fuel, I found the following issues which I find concerning:

1. The fuel attacks the paint on my plane. The paint is an important source of protection against corrosion for the aluminum in the airframe, and it is inadvisable to use a fuel which degrades this protection. Airplanes last for 75 years or more and corrosion protection makes possible the plane's continued airworthiness. In just four months, the fuel has put brown spots on the paint around the filling ports, attacked the plastic port labels installed by the factory, shriveled a plastic label on the fuel selector valve sump drain cover, bubbled the paint immediately adjacent to a fuel vent under the wing, yellowed large areas of the painted surface of the underwing downstream of two fuel vents, lightly yellowed a grating on the leading edge of my wing, lightly yellowed the paint at the edge of a maintenance panel on the upper wing, barely yellowed the edges of the plates around the main fuel tanks gas caps. See the pictures at the end of this report.
2. I am concerned that the fuel may be attacking the chemicals used in the plane's fuel bladders or fiberglass tip tanks, or that there is some other chemical decomposition going on in the wetted fuel component system. This concern is based on three observations and one story:
    a. While flying at 8500' in Mexico with a mix of G100UL and 100LL, I had my cylinder head #3 temperature suddenly go about 40 degrees F cold as evidenced by the cylinder's temperature shown on the engine monitor. The cylinder continued to fire as noted by the engine continuing to run smoothly. The cylinder was likely producing less power as indicated by the colder cylinder head temperature. The chill was caused by reduced fuel flow to the cylinder. I was able to address the problem (ie, get the cylinder head temperature back up) by increasing the overall fuel flow from 13 gallons per hour to 16 gallons per hour. There apparently was some sort of clog in the cylinder #3 fuel injector. This cooling and clogging has never happened to me before in 25 years of operating this plane in the USA and 12 years of operating it in Mexico. Had the clog been

more substantial, the cylinder could have stopped firing completely. Had the problem effected more cylinders, the engine could have stopped, and I could have had to attempt an emergency landing over hostile terrain. As it was, the clog effected the engine on only one leg of the flight. The leaning was normal, the cylinder head temperatures were normal, and the fuel flow was normal on the next leg. The clog happened on the day I returned to the USA, so I was able to have the mechanic take the fuel injectors out and clean them the next day. They reported that the fuel injector on the cold cylinder had some sort of unknown matter in it that they were able to clean out.

b. My plane just completed its annual maintenance on March 26, 2025. The fuel injectors all had a hard shiny black substance on them that the shop had never seen before. The substance could not be removed using the normal sonic cleaner and cleaning fluid. They had to use an old-fashioned gun cleaning solvent to remove the material. The unleaded fuel is supposed to burn cleaner than leaded fuel, and there shouldn't be any deposits on the fuel injectors at all. This material could be evidence of chemical decomposition of something in the wetted fuel system.
c. I have noticed varnish deposits on my oil dipstick, rubbery substances at the top of the dipstick and cap, and an increased friction of the dipstick/cap assembly when removing it or installing it in the engine. Previously, there was only motor oil and a few drops of water at these points and no friction. I note also that the two oil changes I performed on my plane (see attached oil analysis) showed slightly lower viscosity of my Philips X/C 20W-50 motor oil after relatively short oil change intervals. These observations give me concern that G100UL is attacking the chemistry of the lubrication in my engine, or that blowby of foreign substances in the combustion chamber is changing the chemistry of the oil, or causing deposits in the engine that may impair engine performance or reliability.
d. In talking over these observations with an aviation mechanic at my annual maintenance for my plane which has just been completed, he mentioned that he had heard that a boat manufacturer had used fiberglass fuel tanks with a certain resin composition in the fiberglass, and that the resin had leached into the fuel (gasoline with 10% ethanol), gotten into the combustion chamber, had not burned, and then blew by the rings into the oil where it produced gummy rubber substances that interfered with the oil. The manufacturer went to a non-fiberglass fuel tank. My tip tanks are fiberglass and could have experienced a similar issue with the G100UL. I don't use them often, but loaded them fully on one and perhaps two trips to Mexico, and locally in norcal at least one other time. Perhaps the fuel bladders or the tip tanks leached some substance into the G100UL that then showed up on the dipstick. Leaching would be concerning as it would indicate that the material of the fuel bladder or the tip tank is being attacked. A couple of months ago I asked the inventor of G100UL if there would be any material compatibility risk associated with fiberglass tip tanks, and he replied that the tip tanks would be fine. Here is the URL for the fiberglass gas tank incompatibility with 10% ethanol gasoline. https://www.boatus.com/expert-

advice/expert-advice-archive/2020/january/results-of-fuel-and-fiberglass-gas-tank-tests

3. At my annual just being completed, my left muffler had to be replaced due to heat damage. See the picture at the end of the report. It is not clear why this heat damage occurred. The mechanics do not often see this. The damage was on the outside of the muffler, and the individual shock wave cones were fine. Is there some leaning behavior that occurs differently with G100UL than with 100LL, this difference causing heat damage to the muffler? Or was it some other cause? There were at least a couple of backfires on startup during the year since the previous annual. I don't believe we will find the root cause of this damage, but I mention it now in case it is also found in other planes using G100UL fuel. The right muffler was fine. We noted that the G100UL seems to fire more quickly in the engine than the 100LL does, and perhaps that is somehow related.
4. I noticed a much stronger fuel odor in the cabin from G100UL when initially opening the doors after the plane hadn't been used in a at least a day, in comparison with 100LL. Fuel vapors are toxic and shouldn't be inhaled. I had my mechanic look for possible fuel leaks in the fuel system. He said he found nothing, but the strength of the vapors was lower after his work was complete. I was able to mitigate this problem by opening the doors early to air out the cabin before entering. The mechanic's work and the airing of the cabin made this a non-issue going forward.
5. My tip tank sight gauges are dark, and may be darker than they were before using G100UL. It is not certain if the G100UL caused this darkening, or if it is merely the normal darkening of aging with these tip tanks. The tip tank uses a design where you look right through the unpainted strip of fiber glass on the side of the tank to see how much fuel is in the tank. I don't have a good photo to show this.

I note that there are some positive results of my use of G100UL even though they don't outweigh the negative points for me:

1. My two oil changes after using this fuel showed less metal suspended in the oil, indicating that engine wear may have decreased during the time the fuel was used.
2. My climb performance seemed to improve with the fuel, being most noticeable when climbing at max gross weight of 4010 lbs (increased from 3650 lbs with tip tank addition), perhaps delivering 100 to 200 feet per minute improved rate of climb. I did not rigorously document this increase.
3. My fuel burn at 9500' altitude was around .3 gallons per hour lower, dropping from about 13.3 gph to about 13.0 gph with standard leaning technique.
4. The engine started a little quicker with the G100UL.

Conclusion:

I have done my part as an avid proponent of unleaded fuel to bring G100UL to market in our county. I used this fuel knowing that there was not much market history with it, accepting the first-user risks. I continued using this fuel when Textron (the manufacturer of my plane) and Continental (the manufacturer of my engine) issued communications strongly discouraging use

of the fuel. I have determined through personal experience that this fuel is not suitable for my plane. I will no longer fuel my plane with G100UL. I will not consider using this fuel until

- the issues I have observed in my plane have been appropriately addressed, and
- the issues found in other planes during this initial rollout (for instance, see Michael Luvara videos on YouTube regarding G100UL), have been appropriately addressed.

I am proud to have been a member of the group of pilots that first brought UL94 to Reid Hillview, and remain open to trying other unleaded 100 octane fuels in the near term.

Pictures:

Here are many pictures of negative impacts associated with the use of G100UL in my plane. All changes occurred in just 4 months, compared with the 25 years that I have owned the plane with this original coat of factory paint and dipstick.

There was hard shiny black matter running down my dipstick, baked on, thickest at the top of the stick. The mechanic said it cleaned up easily at the annual with solvent. I used to see only oil and sometimes a little condensed water on the dipstick. This photo was taken during the annual, before the mechanic cleaned off the dipstick, cap, and mounting socket. I believe he said mineral spirits were sufficient to remove the black varnish on the dipstick.

This is where the dipstick and cover assembly is installed in the engine. At one time close to the time of the annual I also saw some small rubbery pinkish pellets, maybe 1/16” in diameter, but I didn’t think to take a picture at the time. Normally all I see here is oil and perhaps some water. Based on these disturbing observations, I had the shop change my oil 4 weeks before the annual. Normally I change my oil on 50-hour intervals, but this change came at 29.6 hours.

Here is some black coating on the outside of my fuel injector taken during annual. My mechanic says this coating is not found when 100LL is burned.

The paint is bubbling immediately adjacent to the fuel vent within the air scoop. Yellow degradation is occurring further away from the vent. This fuel vent is located underneath the wing close to the fuselage. Note that avgas will occasionally drain from the fuel vents. For instance, if the tanks are full and the plane is parked in the sun on a hot day, the fuel will expand and drain out of the fuel vent. Or, if the tanks are full, a little fuel may drain out of the vent when cornering on a taxiway.

This is the same fuel vent, with the paint degradation clearly shown in the slipstream going aft and moving sideways at the seams in the sheet metal.

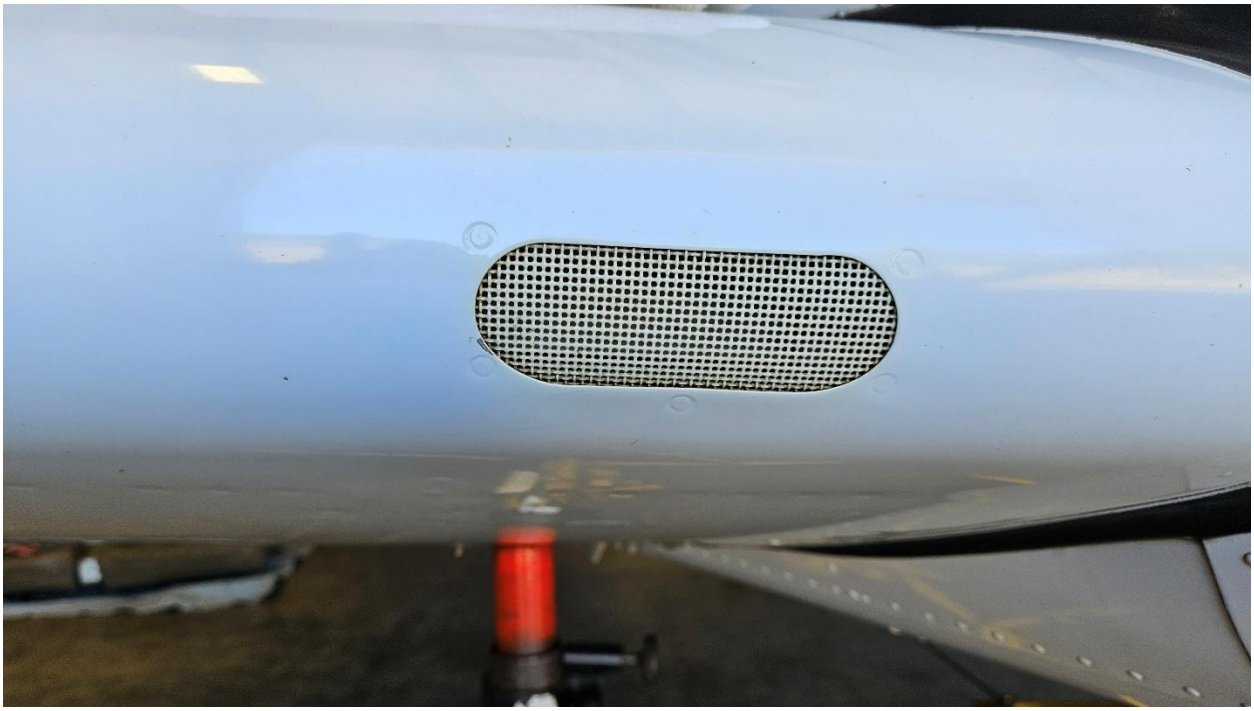
This is the corresponding fuel vent on the other wing. The same degradation pattern is noted.

These spots on the wing next to the gas cap have occurred despite my use of custom-made placemats to absorb light splashes of fuel – There are times a fueler will do the fueling (not me) and cause splashing. 100LL fuelers are the worst because they don't realize the damage that will occur if they allow any splashing from the G100UL inside the tank to occur as the refuel with 100LL. The splashes have attacked the paint and the factory fuel decals. These particular spots occurred in Mexico when my protective placemats were accidentally buried under a lot of luggage and I did not monitor the attendants who pumped the fuel. They were pumping 100LL into a tank that was mostly G100UL. I believe there were some minor splashes out of the tank as it became near full and was probably a mixture of something like 30% G100UL and 70% 100LL. I didn't monitor the attendants – I may have been busy dealing with customs, immigration, airport commandant, or flight plan office at the time.

Here is a picture of the place mat that I modified to serve as a protective barrier for minor splashing while refueling. It was highly effective when used.

Here are the ceramic coating products that I put on the wing to improve its ability to withstand accidental splashing with fuel. I coated about a 3’ x 4’ area around the gas cap. I probably didn’t do it as well as professional would.

This is the access port for the fuel sampling valve under the fuel selector switch. The fuel has attacked the factory label that provides safety instructions for installing the hardware.


This screen on the leading edge has some of the yellow staining associated with G100UL exposure. The mechanic is uncertain how it would get here, other than somehow the gas tank might be venting into the wing and providing fumes that discolor the paint.

This access port has faint yellow staining on the corner. This is not a likely place for fuel contamination and is somewhat of a puzzle as to how the contamination took place.

This is my left side muffler which had to be replaced at this annual maintenance cycle. We are unsure how this damage occurred. Fortunately there is a heat barrier that is installed outside the muffler which did its job in protecting other wiring and assemblies in the engine compartment. There were one or two backfires on start up since the previous annual.

This is the record of G100UL fuel purchases for N4305U at Reid Hillview and Watsonville airports.

Date	Card #	Holder Name	Status	Card	Fuel	Pump Name	Price	Units	Sub Total
12/2/2024 10:56	XXXXXXXXXXX3363	MARSHALL/PAUL A	CLOSED	Discover	G100UL (May Require STC)	G100UL - Pump 4	6.75	51.77	349.45
12/2/2024 14:53	XXXXXXXXXXX3363		VOIDED	Discover	G100UL (May Require STC)	G100UL - Pump 4			
12/2/2024 14:56	XXXXXXXXXXX3363	MARSHALL/PAUL A	CLOSED	Discover	G100UL (May Require STC)	G100UL - Pump 4	6.75	58.27	393.32
1/19/2025 14:52	XXXXXXXXXX1512	BLAKE/ROBERT	CLOSED	AmericanExpress	G100UL (May Require STC)	G100UL - Pump 4	6.75	31.33	211.48
2/9/2025 15:17	XXXXXXXXXXX3363	MARSHALL/PAUL A	CLOSED	Discover	G100UL (May Require STC)	G100UL - Pump 4	6.75	24.46	165.1
2/9/2025 15:25	XXXXXXXXXXX3363	MARSHALL/PAUL A	CLOSED	Discover	G100UL (May Require STC)	G100UL - Pump 4	6.75	27.13	183.13
2/23/2025 15:15	XXXXXXXXXXX4569	ELDER/JAMES P	CLOSED	MasterCard	G100UL (May Require STC)	G100UL - Pump 4	6.75	49.35	333.11
3/9/2025 17:32	XXXXXXXXXXX3363	MARSHALL/PAUL A	CLOSED	Discover	G100UL (May Require STC)	G100UL - Pump 4	6.75	50.88	343.44
								293.19	

Date	Transaction Type	Num	Customer	Memo	QTY	Price	Amount
11/02/2024	Sales Receipt	945	N4305U	Paul Marshall N4305U G100UL	41.8	$ 6.99	$ 292.18
11/16/2024	Sales Receipt	1043	N4305U	Paul Marshall N4305U G100UL	24.4	$ 6.99	$ 170.56
11/25/2024	Sales Receipt	1056	N4305U	Paul Marshall N4305U G100UL	32.1	$ 6.99	$ 224.38
12/08/2024	Sales Receipt	1146	N4305U	Paul Marshall N4305V G100UL	46	$ 6.99	$ 321.54
12/31/2024	Sales Receipt	1220	N4305U	Paul Marshall N4305U G100UL	39.5	$ 6.99	$ 276.11
01/05/2025	Sales Receipt	1252	N4305U	Paul Marshall N4305U G100UL	54.1	$ 6.99	$ 378.16
					237.9	RHV total	
					293.2	WVI total	
					531.1	total gallons pumped	
					11	nautical miles per gallon	
					1.15	statute miles per nautical mile	
					6718.415		

Here is the oil analysis record for my plane showing improved metals results and the slight reduction in viscosity. The last two oil changes occurred while using G100UL.

BLACKSTONE LABORATORIES

OIL REPORT

LAB NUMBER: S191887 **UNIT ID:** N4305U
REPORT DATE: 2/27/2025 **CLIENT ID:** 185097
CODE: 20/216 **PAYMENT:** CC Online (Bulk)

UNIT

MAKE/MODEL: Continental IO-550-B
FUEL TYPE: Gasoline (Leaded)
ADDITIONAL INFO: Beechcraft Bonanza A36, Eng S/N 684839, 1011368
OIL TYPE & GRADE: Phillips XC (A/C) 20W/50
OIL USE INTERVAL: 30 Hours

CLIENT

DANIEL NEAL
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COMMENTS

DANIEL: Thanks for noting the switch in fuel. That doesn't seem to have had any effects on our end. We aren't seeing even a hint of contamination or poor wear to point out from this latest sample. Wear metals are even lower than last time, and that was a healthy report. Everything is in fine standing for 29.6 hours of oil use. The viscosity stayed in the proper range for 20W/50, though it was just a harmless hair below grade last time.

ELEMENTS IN PARTS PER MILLION	MI/HR on Oil	30	UNIT / LOCATION AVERAGES	36	56	70	66	26	UNIVERSAL AVERAGES
	MI/HR on Unit	1,461		1,431	1,395	1,304	1,235	1,169	
	Sample Date	2/14/2025		12/20/2024	9/26/2024	1/18/2024	9/22/2023	3/20/2023	
	Make Up Oil Added								
	ALUMINUM	3	8	4	7	6	6	5	8
	CHROMIUM	2	9	3	5	4	5	5	7
	IRON	19	49	28	43	36	43	34	40
	COPPER	3	4	3	2	2	3	2	5
	LEAD	2626	5993	3925	7713	8176	7117	4716	4413
	TIN	0	1	0	1	1	1	0	1
	MOLYBDENUM	1	4	1	3	2	2	2	4
	NICKEL	3	9	4	5	5	6	7	9
	MANGANESE	0	1	0	1	1	1	0	1
	SILVER	0	0	0	0	0	0	0	0
	TITANIUM	0	0	0	0	0	0	0	0
	POTASSIUM	0	0	0	1	0	0	0	0
	BORON	1	1	1	1	0	2	0	1
	SILICON	4	7	6	4	4	5	4	7
	SODIUM	0	1	2	2	1	2	2	1
	CALCIUM	0	12	1	1	0	1	1	33
	MAGNESIUM	0	1	0	0	0	1	0	1
	PHOSPHORUS	1	203	3	2	1	3	0	412
	ZINC	2	3	2	2	2	2	2	4
	BARIUM	0	0	0	0	0	0	0	0

PROPERTIES			Values Should Be*					
	SUS Viscosity @ 210°F	86.0	86-105	**85.9**	86.7	**85.7**	86.3	87.9
	cSt Viscosity @ 100°C	17.00	17.0-21.8	**16.98**	17.17	**16.93**	17.08	17.48
	Flashpoint in °F	435	>430	445	475	450	455	435
	Fuel %	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5
	Antifreeze %	-		-	-	-	-	-
	Water %	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Insolubles %	0.2	<0.6	0.5	0.2	0.5	0.3	0.4
	TBN							
	TAN							
	ISO Code							

* THIS COLUMN APPLIES ONLY TO THE CURRENT SAMPLE

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LIABILITY LIMITED TO COST OF ANALYSIS

Changes List

V6:

- Add Summary
- Modify the wording that says fueled exclusively in the bay area. Say refueled with 100LL in Mexico. Say that with the tip tanks fully loaded and 70 gallons in the mains, I could make it back to Watsonville or Reid Hillview with around 25 to 30 gallons of gas and would refuel with G100UL.
- Add pictures of the placemats
- Look for term “leaking” and see if “draining” would be better. Explain how fuel come drain from the vent if the tank is full and heats up in direct sunlight, or when cornering while taxiing.
- State that the last oil change was done a couple of weeks before the annual because I was worried about oil contamination issues seeing the long stain on the dipstick.
- Show a picture of the ceramic coating products that I used

- Be more specific about what went wrong in the Mexico refueling with the placemats under luggage and with the attendants not monitored.
- Correct the annual completion date
- Aircraft make/model/year of manufacture
- • Engine total hours and approximate hours using unleaded fuel
- • Any mixing of fuels (unleaded fuel with 100LL fuel, as example)

V5: Corrected publish date, version number

V4: Added photo of dipstick and oil cover socket. Added note about quicker starting with G100UL. Updated the language on a problem found in boats with gasoline in fiberglass tip tanks, and added the URL to the story.