

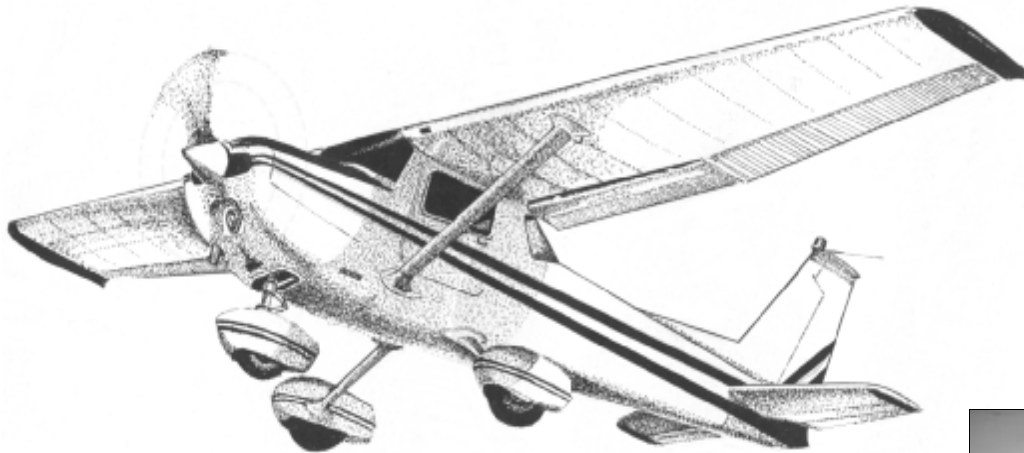
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Fuel Management 101

Part 1

In the summer of 2000 I made my first long cross country trip from California to Oshkosh. My flight planning was done by computer, with fuel stops neatly placed 2.5 hours apart. I soon learned that my planned fuel stops were not always attended, and I was glad that I had at least 45 minutes of reserve on board, as I sometimes had to fly to a nearby airport to find an unlocked fuel pump.

Unfortunately, because I was pressed for time, I didn't flight plan my return trip on the computer, and decided to simply fly home the reverse route. What my neat schedule had not taken into account was headwinds. Flights that had taken two and a half hours North East bound were now consuming more than three hours when headed South West against the prevailing wind. My trip home required some diversions around weather, and I was soon in unfamiliar surroundings. I often found myself nervously searching the pilots guide and GPS for unplanned fuel stops as the clock ticked and the fuel gauges wound down.

On the second day of my odyssey home I made what could have easily been a fatal mistake. On a flight from central Kansas into Oklahoma I became lulled by the steady drone of the engine and daydreamed over the flat featureless terrain. I lost track of time as my aluminum bird steadily but slowly made it's way to the next fuel stop neatly marked on the GPS. I had been in the air nearly three hours when my conscience shifted to the ETE and I got a shot of adrenalin. The time to destination was 40 minutes! I checked and double checked the stop watch and ETE. My engine was firewalled, but I was seeing only 80 kts of groundspeed. No doubt about it, I'd be running out of fuel before I made it to the intended airport! I needed to get the airplane on the ground and sort this out. I found the nearest airport to my current position, set the GPS to "Go To" and was alarmed to discover it was 20 minutes away.

I started a series of mental calculations and procedures. I backed the throttle off for best endurance and watched the GPS ETE climb to 30 minutes. Yikes! I'd been flying at 4,500 ft MSL for better sightseeing of what little there was to see. Should I climb? The laws of physics told me no, I'd slow down and burn more fuel, but the temptation to get more glide distance was strong. I fought the urge, and instead began a 100 fpm descent to increase my speed to the airport. I leaned the engine till it lost a little RPM and left it there. As I became increasingly alarmed about the situation, I tried to think more like an engineer instead of the irresponsible passenger I'd become. Where would I land if the engine

quit? My forehead got clammy, I felt pain in the pit of my stomach, my mouth felt dry, and I began to recognize the tightening signs of the dreaded misguided aviators sphincter.

As the GPS minutes to destination slowly receded, the fuel gauge needles stopped bouncing off "E" and rested firmly there. When I was still 10 minutes out I realized that my decision to trade altitude for airspeed was a poor one. The terrain around the airport was higher than expected, rocky and inhospitable. I found myself at about 500 feet AGL. There was clearly no safe place to land, the rocks and craggy canyons looked close enough to touch, I could clearly see texture in the terrain. I reluctantly increased the rpm by 100 to gain some altitude and fought the urge to pull up. Hoping to buy myself a few more seconds warning if the engine quit, I pulled off my ANR headset, and started listening intently for a change in the engine sound. I focused on keeping my GPS heading to the airport as precise as possible, and tried to keep the wings level. I'd heard of pilots rocking the wings to coax the last few pints of fuel down the pipes, and decided that would be my last resort if the engine started running rough.

I found myself unconsciously holding my breath. This might be a good time for prayer, but I didn't think the man upstairs would look kindly on a request for salvation from such a stupid, self induced predicament. I couldn't help wonder what club members might think if they read of my demise from fuel exhaustion. I clearly knew better, and had published dozens of NTSB accident reports to prove it.

The laws of physics bent the rules that afternoon. The airport at Mooreland, Oklahoma appeared underneath me with the engine still running smooth. I made a steeper than normal approach and taxied up to the fuel pump, with a knot still in my stomach. The fellow from the FBO wore a wide brimmed cowboy hat, and graciously offered to top off the airplane while I walked off my tension under the pretext of looking at interesting airplanes inside open hangars.

When I got back to the airplane the attendant commented that he'd never gotten 22 gallons into a Cessna 150 before... "Uh-Huh" was all I could stammer. Twenty two gallons...I was down to two quarts useable, maybe five minutes left.

I know I was luckier than I deserved. Pilots run out of fuel all the time, lots of them die as a result. When I was a student pilot I didn't really get it. How could anyone be so stupid as to run out of fuel in an airplane? Now I knew better. I considered myself a responsible, proactive pilot, and it yet I had blundered my way into a near death experience.

When we talk about fuel management, several issues come to mind. The most obvious path to survival is to fill the tanks to overflowing before every flight, and get the airplane on the ground before the tach exceeds 2.5 hours of operation. In spite of my own checkered fuel management history, I have little sympathy for pilots who run out of fuel on short local flights or while doing touch and goes in the pattern. There simply is no excuse for running the airplane dry when you're not going anywhere.

Despite its "Commuter" designation, a Cessna 150/152 with standard tanks is hardly a cross country optimized airplane. It's a real shame the airplane flies so much better when it's not loaded over gross. Since losing weight is much tougher than losing fuel, the "how much fuel do I really need" question rears its awkward head before every cross country excursion. Pilots with the luxury of long range tanks have less to worry about, as the human bladder is a fairly reliable fuel management device, but then those airplanes are at the mercy of gross weight restrictions and even worse performance in high density altitude conditions.

This article is the first in a series where we will tackle every aspect of fuel management in Cessna 150-152's. We'll look at the fuel system itself, how it is configured, and the compromises in design that must be considered by pilots who would prefer to die in bed. We'll look for obvious solutions to fuel management, like how to accurately calculate fuel consumption, and how much fuel is actually in the tanks. We'll look at the relationship of leaning to fuel burn, and differences in range if using auto fuel. We'll give tips on tracking fuel consumption in real time, and simple reminders to avoid painting yourself into a corner as I did in the story above. Finally, in a future article in this series we'll look at more elaborate and expensive solutions, such as installing fuel consumption computers and auxiliary tanks.

At its most basic, fuel management boils down to two simple pieces of information. How much useable fuel does the airplane contain, and how fast does it use the fuel? With those two numbers and a wristwatch, anyone can be a master of fuel management.

We can start this process by reviewing the POH. A Cessna 150 with standard tanks holds 26 gallons of fuel, of which 22.5 is useable (24.5 gallons in a C152). Those are hard facts. Unfortunately the second critical piece of the puzzle is harder to lock down. Cessna does provide fuel consumption information in the POH on a table labeled "Cruise Performance."

The Problem with the POH

In 1978 aviation manufacturers agreed to standardize both the layout and performance benchmarks for all general aviation models operation manuals so that transitioning from one airplane to another would be easier for the pilot. Prior to this, the Cessna POH was actually an "Owner's Manual." According to Guy Maher, a former Cessna test pilot, the Cessna Owners manuals prior to 1978 were an uneven mix of ballpark optimism, marketing based conclusions, and theoretical projections.

In a nutshell, Cessna test pilots flew carefully rigged airplanes with no antennas, measuring their performance at 2,500, 7,500 and 12,500 feet. In between altitude performances were arrived at by applying slide rule math. In order to keep things neat, rounding of results was sometimes required, and typically performance was rounded to the optimistic side.

Prior to 1978, Cessna did not include fuel reserves on the cruise performance chart. Times given were to dry tanks. See the footnote at the bottom of the chart: "In the above calculations of endurance in hours and range

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Postmaster:
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Contacts:
Postal Address: See Above
Telephone: (805) 461-1958
Website: www.cessna150-152.com

Email: Items for publication:
editor@cessna150-152.com

Email: General Inquiries, Membership, Requests for Technical Materials, Back Issues, etc:
membership@cessna150-152.com

Fuel Management 101 (Continued from page 3)

in miles, no allowances were made for take-off or reserve.” Note also that the chart contains a subtitle “WITH LEAN MIXTURE.”

Here’s a digest of the official cruise performance chart:

1966 Cessna 150 Owners Manual Cruise Performance at 2,700 RPM*			
Altitude	GPH	Endurance 22.5 gal	Endurance 35 gal
2,500	6.8	3h 18m	5h 12m
5,000	6.2	3h 36m	5h 36m
7,500	5.7	3h 54m	6h 6m
10,000	5.3	4h 12m	6h 36m

*your performance will vary

Note that that by selecting 2,700 rpm we are attempting to stay on the conservative side of optimism. Now let’s see if we can modernize this chart for real world operations. While later versions of the POH describe fuel ratios for take off and climb, to keep things simple we’ll base our revised chart below for time elapsed only, starting the clock on the takeoff roll.

We will take Cessna’s GPH figures as gospel at this point until such time as we can prove otherwise with our own more personalized operational tests. We’ll start

Cessna 150 Cruise Performance at 2,700 RPM with 45 minute fuel reserve*			
Altitude	GPH	Endurance 22.5 gal	Endurance 35 gal
2,500	6.8	2h 33m	4h 27m
3,500	6.5	2h 42m	4h 37m
4,500	6.3	2h 49m	4h 48m
5,500	6.1	2h 55m	4h 58m
6,500	5.9	3h 3m	5h 10m
7,500	5.7	3h 11m	5h 23m
8,500	5.5	3h 20m	5h 36m
9,500	5.4	3h 24m	5h 43m

*your performance will vary

by agreeing that a 45 minute fuel reserve is prudent. Next we’ll extrapolate the fuel consumption figures for operations at typical VFR operating altitudes.

For most of us, C150 operations above 7,500 feet are a rarity. For the purpose of discussion, lets compare the range between 2,500 and 5,500 feet with standard tanks. The difference between the greatest and least endurance at these typical operating altitudes is just 22 minutes. An easy ballpark preflight method would be to simply average the fuel consumption for the expected altitude and direction of flight:

For VFR operations 3,500-5,500 with an Eastern bearing: 2h 48 minutes (average)

For VFR operations with an Western bearing 4,500-6,500 ft: 2h 56 minutes (average)

We mentioned that the Cessna factory numbers are optimistic, but by how much? Realistically, each airplane will produce different numbers depending on everything from the condition of the engine, to piloting techniques from leaning to rudder coordination. But just how far can we go wrong using the factory specs? Getting out the slide rule again, we calculate that a 45 minute fuel reserve is a 29% safety margin at 2,500 ft and a 22% margin at 9,500 ft. If we assume a 30 minute legal VFR reserve instead, the margin is narrower, 17% at best, and 13% at worst. Note that difference between the manufacturers best (10,000 ft) and worst (2,500 ft) fuel economy is precisely 22.5 % In our view, the 20+ % margin that comes with a 45 minute reserve is a sufficient starting place for determining your own fuel planning agenda.

Ideally, you’ve been writing down the tach hours at each fuel stop. If so, you can get a pretty accurate GPH average by dividing the total tach hours by the fuel consumed. Because performance varies significantly with altitude, you should consider this average a “block” rate, useful for approximate preflight fuel planning. Whether or not you have kept track in the past, it is extremely useful to determine a maximum, worst case, GPH block rate. If you don’t have the time or inclination to determine this for real, we suggest using Cessna’s numbers for 2,500 feet rounded up 15% which would equal 7.8 gallons per hour. Sound high? Look at the chart again. The often quoted 6 gallons per hour rate only applies above 6,000 feet, and let’s remember that our figures are for total time aloft, for which a climb to 6,000 is often a thirsty, drawn out affair. On the other hand, if you’re the sort who enjoys some performance test flying (or will jump on any excuse to fly) Let’s get in the airplane and find out how much fuel we’re really using...

Test Flight: Finding Your Own Max Block GPH.

You'll need a stopwatch. In the future you'll usually rely on the tach for an accurate average, but it will be helpful in the beginning to compare tach time to actual clock time. Don't use the Hobbs meter for timing this test. Tach time has a solid relationship with fuel consumption, if the tach runs faster, you burn more fuel, so the Tach is a reliable fuel consumption timer. Choose a destination that's at least one hour flying time away. (two hours would be better as long as the destination has fuel available.) Try to park on a level spot and fill both tanks all the way to top of the filler necks. Write down the tach time and start the stopwatch just before you firewall it for takeoff.

If it is safe to do so, fly to the destination between 2,500 ft and 4,500 ft MSL, unless you normally fly higher in your area. Your goal is to fly the entire route with the engine at maximum rpm without operating in the red rpm range. You should maintain a full rich mixture, no carb heat unless required for safety. (Obviously you will reduce rpm and use carb heat as normal when flying in the pattern at the destination.)

When you land, stop the watch as soon as you clear the runway, and taxi immediately to the fuel pump. Write down the tach and stopwatch times. They should be quite close. If not, make a note of the difference. Remember that the tach counts portions of an hour as decimal time, not minutes. To make the conversion, multiply any portions of an hour of tach time by 60 to get minutes.

Fuel the airplane to the top of the filler necks again, and note the amount of fuel consumed on your trip. If you are able, repeat the process on the return trip. Whether you perform the test one way or round trip, all that's left to do is divide the total fuel used by the elapsed tach time. For example: if you consumed 13 gallons on a 1.73 hour (tach) flight, your block fuel consumption rate would be 13 divided by 1.73 = 7.5 gallons per hour. Once you have this max block rate, you can do your future fuel flight planning with confidence. Here's a quick primer (use your own consumption rate of course.) In our example, fuel consumption is 7.5 gallons per hour. Our example airplane has standard tanks, with 22.5 gallons useable fuel. Divide the useable fuel by the consumption rate. This neatly works out to 3.0 hours tach time. By the way, since we'll be relying on the tach for our future flight planning calculations, we want to do all math in tach time, not clock time. Next we need to establish our fuel reserve. For VFR flying, we recommend a 45 minute fuel reserve (1 hour for IFR). Converting reserve time minutes to tach time is easy, simply divide by 60. 45 minutes divided by 60

= .75 minutes tach time. 3 hours minus .75 hours fuel reserve leaves us with a maximum flight time of 2.25 hours, or 2 hours and 15 minutes on our wristwatch.

As a practical matter, you can use a backwards version of this formula each time you top off the tanks to see if your block calculations are accurate, and evaluate if you are maintaining your personal fuel minimums.

Here's how it works: In our example we should never have less than 5.6 gallons of useable fuel in the tanks. (7.5 gallons x .75 tach time) Our total tank capacity is 26 gallons, add the 3.5 gallons unusable to our 5.6 gallons reserve = 9.1 gallons. 26 gallon tanks minus 9.1 gallons = 16.9 gallons. Round this number to 17 for simplicity. Bottom line: If we ever manage to get more than 17 gallons into the tank at top off time, we've crossed the line and exceeded our minimum fuel reserve.

Now you say, "9 gallons is 54 pounds of fuel. That's 54 pounds of payload lost for no other reason than insurance." Consider this. The FAR's require 30 minutes of fuel reserve for VFR flying. If we decide to follow the letter of the law, we can cut 15 minutes off our safety zone, and lose an extra 1.9 gallons of fuel, gaining just over 11 pounds of payload. Only you can decide if your life is worth putting on the line for that margin.

Test Flight 2: Practice Sweating.

Choose a personal fuel minimum based on your own opinion of what is prudent. With more than enough of fuel on board, pick an airport in your area as a sample destination. Fly there as if you were planning to land. When you enter the downwind, assume that another airplane has made a gear up landing on the only runway and you can't land. Start your stop watch and head for the nearest available airport. Pretend as you fly to the alternate that you have passed your personal fuel minimum and are now flying on your reserve. Watch the clock as you fly to the alternate and compare the ticking time to your imaginary remaining fuel. Even if the alternate airport is nearby, we'll bet you'll be surprised how long it takes to get there. If you're a glutton for punishment, when you get to the alternate, pretend it has gone below minimums and go on to a third airport.

Obviously you should have more than enough actual fuel onboard to make this test flight safely. Let's say you've decided that 30 minutes is enough. If you're any good at simulations, as the clock ticks down to 15 or 20 minutes you ought to be feeling a little tight in the sphincter. About now wouldn't an extra 15 minutes of fuel be a welcome companion?

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Fuel Management 101 (Continued from page 5)

Once you have a maximum tach based block fuel rate, you can safely plan your flights around it without going into deeper detail. For those who enjoy the nuts and bolts of more precise fuel planning, use the chart from your POH or use our chart on page 4 as a starting point. In any case, you should keep a log of your all your fuel stops with the tach time noted for future reference.

An Easy Reminder

Here's what we do in the cockpit to keep track of fuel use: In this example we'll assume that our max block rate is 7.5 gallons per hour, and the tanks are full. We previously calculated that our maximum flight time with a 45 minute reserve is 2.25 hours tach time. We add 2.25 to the current tach time, and write the total on a small brightly colored post it note (the kind college students use to bookmark study passages). We stick the note right to the face of the tach, just below the elapsed time display. Then during the flight, every time we look at the tach, we get a reminder of the maximum tach time before landing. Simple, easy, works.

What About Less Than Full Tanks?

Most of us have been using some kind of fuel dipstick since our student pilot days. If you haven't, shame on you! It's been years since there's been a commercially produced fuel dipstick for Cessna 150's so they usually have to be home made. C152 pilots with standard tanks commonly use a clear Lucite "FuelHawk" tube made by the J-Air Company. There's no FuelHawk dipstick available for 150's or either model with long range tanks, though the company does make a universal gauge that can be calibrated for any fuel tank. We decided to find out how accurate the C152 Fuel Hawk is and what the results were when used on a C150.

FuelHawk Lucite C152 Stick, for a standard 152 tank (13 gallons total, 12.25 gallons useable)

The FuelHawk uses a sliding scale

This can be approximated as follows:

Between 0 and 6 gallons useable $13/64$ inch = 1/2 gallon

Between 6 and 12 gallons useable $14/64$ inch = 1/2 gallon

For our purposes, the nearest 32nd of an inch is accurate enough.

From the bottom of the tube:

Top of the 0 gallon useable is 1 & 4/32"

Top of 1/2 gal useable is 1 & 11/32"

Top of 1 gal useable is 1 & 17/32"

Top of 1.5 gal useable is 1 & 24/32"

Top of 2 gal useable is 1 & 31/32"

Top of 2.5 gal useable is 2 & 2/32"

Top of 3 gal useable is 2 & 9/32"

Top of 3.5 gal useable is 2 & 16/32"

Top of 4 gal useable is 2 & 23/32"

Top of 4.5 gal useable is 2 & 30/32"

Top of 5 gal useable is 3 & 1/32"

Top of 5.5 gal useable is 3 & 8/32"

Top of 6 gal useable is 3 & 15/32"

Top of 6.5 gal useable is 3 & 22/32"

Top of 7 gal useable is 3 & 29/32"

Top of 7.5 gal useable is 4 & 4/32"

Top of 8 gal useable is 4 & 11/32"

Top of 8.5 gal useable is 4 & 18/32"

Top of 9 gal useable is 4 & 25/32"

Top of 9.5 gal useable is 5"

Top of 10 gal useable is 5 & 7/32"

Top of 10.5 gal useable is 5 & 14/32"

Top of 11 gal useable is 5 & 21/32"

Top of 11.5 gal useable is 5 & 28/32"

Top of 12 gal useable is 6 & 2/32"

FuelHawk Observations:

By the supplied scale, unusable fuel (.75 gallon) should appear 9/32" from the bottom of the tube, but the actual "0" fuel mark is 1 & 4/32" from the bottom. It appears the Fuelhawk designers built in a 45 minute reserve by padding the unusable scale, quadrupling it to 3 gallons. This translates into approx 22 1/2 minutes of additional running time (per tank) at full power.

While the intent of building in this reserve is noble and no doubt designed to reduce the manufacturers liability, it means the rest of the scale must be compressed or the top of the tube would show less than 12 gallons useable. The less fuel there is in the tank, the less accurate the diptube becomes. At 12 gallons (full) the tube is a quarter gallon long of accuracy. Under that, each gallon shown represents approximately 1.25 gallons actual fuel. On the plus side, this means the tube is progressively more conservative as you use fuel. On the down side, it takes mental math to get the true figure.

We would argue that the closer you are to empty, the

more important accuracy becomes. In a sense, the FuelHawk communicates a dishonest message, somehow more than two gallons of fuel has simply disappeared, but as if by magic, the tank still holds 12 gallons of useable fuel. We get the idea behind this, but wouldn't it have been more straightforward to mark the useable fuel accurately? With an unmarked 22.5 minute reserve per tank the dipstick would simply show that only 10.75 gallons were available when the tank was full. No doubt this might confuse some student pilots, but ultimately we'll bet money they'll trust the tube more than the POH. Let's imagine some real world applications of running near empty and needing accurate fuel quantity figures:

On a cross country trip you land to get fuel and discover that the FBO is out of fuel or closed for the day, and there's no fuel to be had. Do you have enough fuel to get to the next airport safely?

Assume the following: Conditions are day VFR and the nearest airport with available fuel is 40 statute miles away (direct by GPS)

Working the problem backwards, you allow an average ground speed of 80 mph for a total flight time of 30 minutes. (This takes into account your reduced ground-speed during takeoff and landing). Assuming your fuel consumption is 6 gallons per hour, it will take approximately 3 gallons of fuel to reach the destination.

You dip the tanks with the FuelHawk and find you have 1 gallon useable on one side and 3 gallons on the other. *Uh Oh, that's just 10 minutes of padding, not enough to be legal or safe.* But what about that extra 45 minutes of FuelHawk padding? If you assume your airplane burns an average of 6 gallons an hour, and you account for the FuelHawk padding, you can legally and safely proceed to that destination. Still, even though you know it's there, it is unsettling to not see that reserve fuel on the scale. When you are playing it this close to the limit of endurance it would be reassuring to know exactly how close you are to the legal and safe limit without the mental gymnastics.

In order to keep the flight above safe, and reduce the sweat on your brow, we would not proceed to the next airport without the following: You must be confident in both the weather and your ability to find the other airport. Unless you are intimately familiar with the geography, this means an accurate and reliable GPS is a requirement. Not only will the GPS lead you to the destination via the most efficient route, but it will also apprise you of your progress in real time. In order to account for winds, we would use a stop watch as well. This means 15 minutes into the flight we should be no

further than 20 miles GPS from the destination. If, for example, at 15 minutes we are still 25 miles from the destination, we're only averaging 60 mph, and the flight will take approximately 40 minutes instead of 30. If we expect to land with a legal VFR 30 minute reserve we are cutting it pretty close at that point. In a case like this, the only sane course of action is to select a turn back point before you even start the engine. Assuming good VFR weather, non towered airports with minimal traffic, and good navigation, prior to startup you should firmly decide "If I am not X miles from the destination X minutes into this flight, I will turn around and come back to the departure airport." In this example, with our 10 minutes of padding, and some fudging, we'd turn around if we weren't 20 miles from the destination at 20 minutes into the flight.

The FuelHawk designers probably intended for their padding to instill pessimism. They assume if the pilot dips the tanks and comes up close to Zero, he or she will conclude they can't continue without additional fuel.

Unfortunately, this assumption could have the opposite effect. A pilot dips the tanks, sees close to Zero, and is not really alarmed. After all, there's a 45 minute reserve underneath that Zero! While technically true, this is the most dangerous kind of optimism. There are literally hundreds of pilots who have crashed in 150/152's by running out of fuel short of the airport. You're an Optimist? Good for you. Just don't forget that unlike our hypothetical example, the weather doesn't always hold up, traffic isn't always light, winds aren't always in your favor, and sometimes finding the airport is tougher than you expected. Are you willing to bet the farm with that hand of cards?

As a general policy, we favor padding the unusable fuel indication slightly, but only by a small enough margin to account for things like sampling the fuel on a less than level surface. (approx 1/4 gallon per side) In a nutshell, in a matter of possible life or death, we'd rather the dipstick gives us the unvarnished truth. A good way to indicate the criticalness of those last 2 gallons would be to mark them in red, or even better annotate the bottom of the dipstick in minutes remaining. This works out to approximately 5 minutes remaining for every 1/4 inch above Zero. You want to land with the legal VFR reserve fuel in the tanks? Even if you're just going around the pattern once it can't happen unless you have at least 20 minutes of fuel on each side. Seems pretty straight forward to us.

What about using a 152 FuelHawk tube on a Cessna 150? Ironically, the 152 FuelHawk is more precise on a

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150 than it is on a 152. For starters, remember that the 150 tanks have a full gallon less usable fuel on each side than the 152. This means the 2.25 gallon 152 FuelHawk padding is reduced to just 1.25 gallons. For our purposes we will round up the unusable fuel by .5 gallon for each airplane giving us a neat 2 two gallons unusable for the C152 and four gallons unusable for the C150. Here's how it works out for each marking on the FuelHawk on each airplane:

FuelHawk Gallons Indicated Useable	C152 Actual Gallons Useable*	C152 Runtime Minutes Padded	C150 Actual Gallons Useable*	C150 Runtime Minutes Padded
0.0	2.00	20.0	1.00	10.0
0.5	2.42	19.2	1.45	9.5
1.0	2.84	18.4	1.91	9.1
1.5	3.25	17.5	2.37	8.7
2.0	3.67	16.7	2.83	8.3
2.5	4.09	15.9	3.29	7.9
3.0	4.50	15.0	3.75	7.5
3.5	4.92	14.2	4.21	7.1
4.0	5.34	13.4	4.66	6.6
4.5	5.75	12.5	5.12	6.2
5.0	6.17	11.7	5.58	5.8
5.5	6.58	10.8	6.04	5.4
6.0	7.00	10.0	6.50	5.0
6.5	7.42	9.2	6.96	4.6
7.0	7.83	8.3	7.41	4.1
7.5	8.25	7.5	7.87	3.7
8.0	8.67	6.7	8.33	3.3
8.5	9.08	5.8	8.79	2.9
9.0	9.50	5.0	9.25	2.5
9.5	9.92	4.2	9.71	2.1
10.0	10.33	3.3	10.17	1.7
10.5	10.75	2.5	10.62	1.2
11.0	11.17	1.7	11.08	0.8
11.5	11.58	0.8	11.54	0.4
12.0	12.00	0.0	12.00	0.0

*.25 extra gallons unusable padded to each tank

Making Your Own Fuel Dipstick

We decided to calibrate our own fuel dipstick as accurately as possible for a working model. To start with, we compared the Fuel Hawk with a now discontinued wooden dipstick produced by AVI-AID. The AVI-AID stick marked un useable fuel as the bottom 7/8" of the stick, with each gallon above that 1/2" higher.

Real Life

Using the Fuel Hawk and AVI-AID dipsticks as a starting point, we began the process of actually measuring fuel in both standard and long range 150 tanks. We didn't have a 152 on hand for comparison, but assume that the dipstick measurements would be the same, with the scale moved down exactly one gallon more useable.

We began with the long range airplane, checking to make sure it was level in the hangar. We drained out all the fuel from both the gascolator drain and the low point belly drain sump. For filling we used portable pickup truck mounted supply tank, a calibrated one gallon pitcher, and a 3/8 birch wood dowel, cut 14" long so it couldn't accidentally fall into the tank. We added fuel into the right hand tank one half gallon at a time, dipping the tank and marking the dowel with a Sharpie pen.

Confusion Ensues.

Draining the tanks took about two hours, and then the process of refilling the right tank began. The first problem we discovered is that it was difficult to determine exactly where the wet part of the stick ended and the dry began. The longer we left the stick in the tank, the more fuel seemed to "wick" up the stick, making it hard to see the true fuel level. We next tried using wood stock made of Oak, hoping that the harder wood would wick less, and it did, but it was still tough to see the exact line. One thought is that a stick stained a dark color would show the line more readily, but we didn't want to get sidetracked looking for a wood stain that wouldn't dissolve in Avgas. Ultimately we switched the all purpose Lucite FuelHawk tube, and found it was much easier to read than a wood stick.

Interestingly, the first and second half gallons each displaced about 1/2", but then subsequent half gallons only displaced 1/4". Then around gallon 5 something went awry. At this range the fuel level didn't go up at all, until we'd added nearly two more gallons, and then it only went up 1/8". We suspected that fuel was traveling to the other tank through the cross vent tube, and sure enough, we found more than two gallons in the supposedly empty left tank. Back to square one. Drain the tanks. Disconnect and cap the crossover. Fill again. This time, we got crossover through the fuel on/off



valve at around 8 gallons. It seems the gravity fed fuel pressure is high enough at that point to push the fuel all the way up the opposite down tube and into the other tank. Simple physics! We kicked ourselves for not realizing it sooner. Obviously the shutoff valve needs to be closed! Once again, drain the tanks and start over. Our third fill was better, but still seemed imprecise, the level from one gallon to the next was oddly different, and in no particular pattern. Then, a moment of insight! Why not fill the tanks first, drain them off a gallon at a time, and measure the fuel remaining? Eureka! (If you're laughing at this point, we won't blame you.)

Day three, full of enthusiasm and smelling of Avgas, we capped the fuel and vent lines to the opposite tank, and filled the tank to the top of the filler neck. Like the opposite process, there was a big drop at the start, the first gallon out dropped three calibration lines on the tube, while each subsequent gallon dropped just one (on long range tanks.) We have to assume that fuel in the filler neck accounts for the extra height in the tube, and cannot be accurately measured. Finally, after three days of practice, we had a linear measurement of fuel drained. We were somewhat surprised that the total tank capacity was nearly as advertised, 19.5 gallons. It's likely the plumbing from the tanks to the gascolator accounts for the extra .5 gallon.

We repeated the process for the standard tank airplane with equal success. Once again, it seems Cessna did not pad fuel capacity, the actual tank capacity measured 13.25 gallons, including fuel in the lines. Our conclusions: For the standard tanks the AVI-AID measurements are right on, with only a slight change for sim-

plicity. For the 150 standard tanks, mark the dipstick every half inch up from the bottom, with the bottom inch marked as unusable. That way, like our rounded up FuelHawk calculations, you'll be padding the total unusable fuel (both tanks) by half a gallon, or aprox 5 minutes of run time. You can't fly even a single traffic pattern in 5 minutes, so it's not a significant amount of padding, but it's erring on the side of caution, and keeps all the measurements even. For a 152 with standard tanks, mark the bottom 3/4 inch as unusable, and then every half inch above that as one gallon. In part 2 of this series, we'll look closer at fuel system plumbing, uneven flow and venting, fuel gauges, and after market fuel flow computers.



Home Made Fuel Dipsticks Measure From Bottom of Stick

Gallons Useable	C150 13 Gal Tank	C152 13 Gal Tank	C150 19 Gal Tank	C152 19 Gal Tank
18.75				Full
18.5			Full	6-6/16"
17.5			6-4/16"	6-1/16"
17			5-15/16"	5-12/16"
16			5-10/16"	5-7/16"
15			5-5/16"	5-2/16"
14			5"	4-13/16"
13			4-11/16"	4-8/16"
12	Full 11.25 gal	Full 12.25 gal	4-6/16"	4-3/16"
11	6-1/2"	6-1/4"	4-1/16"	3-14/16"
10	6"	5-3/4"	3-12/16"	3-9/16"
9	5-1/2"	5-1/4"	3-7/16"	3-4/16"
8	5"	4-3/4"	3-2/16"	2-15/16"
7	4-1/2"	4-1/4"	2-13/16"	2-10/16"
6	4"	3-3/4"	2-8/16"	2-5/16"
5	3-1/2"	3-1/4"	2-3/16"	2"
4	3"	2-3/4"	1-14/16"	1-11/16"
3	2-1/2"	2-1/4"	1-9/16"	1-6/16"
2	2"	1-3/4"	1-4/16"	1-1/16"
1	1-1/2"	1-1/4"	15/16"	12/16"
0	1"	3/4"	10/16"	7/16"

January/February 2003 Accidents

Important: The Cessna 150-152 club publishes these accident reports in the hope that readers will consider the role that each pilot's decisions played in the outcome and learn from the experiences of others. These reports are solely based on preliminary NTSB reports which may contain errors. They have been edited for clarity. They are not intended to judge or reach any definitive conclusion about the ability or capacity of any person, aircraft, or accessory.

Friday, January 03, 2003

Jessup, GA

Cessna 150K, N6098G

1 Uninjured.

The airplane made a forced landing at about 9:12 am after a partial loss of engine power. The pilot was not injured, but the airplane was substantially damaged. Conditions were VFR. The flight originated from Brunswick, Georgia at about 8:30. The pilot reported that about 40 minutes into the flight, engine rpm suddenly dropped from 2,400 to 1,500 rpm. The pilot applied carb heat and made adjustments to both the mixture and throttle settings, but could not restore full power. The pilot then told ATC of his loss of power and intentions to make an off airport landing. He maneuvered the airplane for a landing on a service road. During the landing flare, the left wing tip struck a small pine tree that was not visible during the approach. The airplane cart wheeled to the left, and nosed over in soft soil. The left door popped open, and the pilot was able to exit the airplane. An examination of the airplane after recovery found only residual fuel in both tanks, no fuel was found in the carburetor bowl. The impact damaged propeller was straightened, fuel was added, and the engine was started and operated satisfactorily to 2,000 rpm. Safety concerns about the damaged propeller prevented operation at a higher rpm.

Wednesday, January 08, 2003

Garner, IA

Cessna 150J, N60834

1 Uninjured.

At about 12:30 pm, the airplane, piloted by a student, made a forced landing after a loss of engine power. During the landing the nose gear collapsed, and the airplane nosed over. The pilot was not injured. Conditions were VFR. No further details were available.

Wednesday, January 08, 2003

Traverse City, MI

Cessna 152, N757LE

1 Uninjured.

At 3:56 pm the airplane was substantially damaged by a

hard landing on runway 18 (5,107 feet by 150 feet, asphalt), at the Cherry Capital Airport, Traverse City, Michigan. Conditions were VFR, the student pilot was not injured.

Saturday, January 11, 2003

Everglades City, FL

Cessna 150K, N5629G

1 Serious, 1 Minor Injury.

At about 1:53 pm the airplane crashed into the water at the end of the runway after an aborted landing at Everglades Airpark. The airplane was being used for instruction, and conditions were VFR. The airplane was substantially damaged, the CFI received minor injuries, and the dual student received serious injuries. The instructor reported that the student was on a stable approach, cut power when crossing the runway threshold and immediately started the landing flare. The airplane bounced on the runway and the student advanced the throttle to initiate a go-around. The airplane pitched up and banked approximately 10 degrees to the left. With both the student and instructor on the controls, the airplane banked right toward the runway. The student then let go of the controls. The aircraft continued to the right off the runway and struck runway edge lights. The instructor continued the go-around, raised the wing flaps, and checked that the carburetor heat was off. The airplane was airborne off the end of the runway but performance was poor. To avoid trees beyond the water inlet off the departure end, the instructor initiated a shallow left turn and ditched the airplane in the water. The right wheel impacted the water and rotated the airplane about 180 degrees. The instructor and the student then exited the airplane through the broken windshield. The dual student reported that the airplane stalled, rolled to the right, and hit the water left wing and left side first. He remembers being under the water and being paralyzed due to a vertebrae injury. The instructor came back to the airplane, unbuckled the student's seat belt and took him to the surface. Other witnesses reported that the airplane ran off the right side of the runway and collided with runway lights and a sign. The airplane lifted off at full power with the elevator in full up position and climbed to about 60-100 feet. The airplane then stalled and spun to the right. About 1/4 turn into the spin, the airplane crashed into the water.

Sunday, January 12, 2003

Charleston, MO

Cessna 150M, N66507

1 Uninjured.

The recreational licensed pilot made a hard landing at about 1:00 pm at Mississippi County Airport. Condi-

(Continued on page 11)

January/ February Accidents (Continued from page 10)

tions were VFR. The pilot was not injured. The pilot reported elevator control stiffness during his first approach for landing. He executed a go-around which was then followed by the accident landing.

Thursday, January 16, 2003**Salinas, CA****Cessna 152, N25562****1 Uninjured.**

At 2:20 pm a student pilot on a solo cross country flight lost control of the airplane on takeoff. The airplane veered off the runway and flipped over. The airplane was substantially damaged but the pilot was not injured. Conditions were VFR. The flight departed from King City, CA and was enroute to Reid-Hillview Airport San Jose, CA, with a planned stop at Salinas. The pilot reported that a strong crosswind pushed the airplane off the runway, until it went onto the dirt. The nose gear dug into the dirt and the airplane flipped over.

Sunday, January 19, 2003**Crestline, OH****Cessna 150F, N8555G****2 Uninjured.**

At about 5:00 pm the airplane struck a tree while attempting to take off from a snow covered farm field. The private pilot and his passenger were not injured but the airplane's left wing was substantially damaged. Conditions were VFR. The flight originated from Beach City, Ohio. After a 2 hour flight, the engine lost total power, and the pilot performed a forced landing to the plowed snow covered farm field, about 9 miles east of Mansfield Lahm Regional Airport (MFC). The pilot proceeded by ground transportation to MFC, where he purchased fuel. Upon returning to the airplane, the pilot added the fuel to the left and right wing tanks, and a mechanic inspected the airplane. The pilot then elected to attempt a takeoff from the field. During the takeoff roll, the left wing struck a tree, and the takeoff was aborted. (*editors note: Does it seem logical to make this off airport departure with the passenger aboard when the passenger could have easily returned to the nearby airport by car?*)

Tuesday, January 21, 2003**Norman, OK****Cessna 152, N47257****1 Fatality.**

At 12:30 pm the airplane crashed and was destroyed near Norman, Oklahoma. The instrument rated commercial pilot, sole occupant of the airplane, was killed. The airplane was on a pipeline patrol flight. Conditions were VFR. The flight was reported to have made a refu-

eling stop at the Chickasha Municipal Airport ten minutes prior to the accident. The airplane, was powered by an upgrade 150-horsepower engine, and was operating in the restricted category with an approved auxiliary fuel tank installed in the baggage compartment. One witness reported that the airplane was circling low over a freshly disturbed pile of dirt near the pipeline. Another witness said that the airplane was flying low in an "erratic manner as if no one was at the controls." The airplane impacted trees and terrain on a 050 degree magnetic heading. The bottom of the engine and the lower forward portion of the cockpit were found partly buried in the ground in about a 40-degree nose down attitude. The flap actuator was found in fully extended position (30-degrees). All aircraft components were found within a 20 foot radius of the wreckage. Flight control continuity was confirmed at the accident site. The weather at the nearby Westheimer Airport was reported as clear, with a visibility of 10 statute miles, winds from 030 degrees at 15, gusting to 19 knots.

Tuesday, January 28, 2003**Ellensburg, WA****Cessna 152, N48769****1 Uninjured.**

At approximately 2:15 pm the student pilot lost control of the airplane on landing at Bowers Field. The airplane was substantially damaged, but the pilot was not injured. The flight departed about 55 minutes prior to the accident. The operator reported that this was the student's second solo flight. On the accident landing the pilot reported that the airplane was lined up with the runway 29 centerline, airspeed was 60 knots, and the VASI showed red over white. Touch down was made just after the numbers. After touchdown, the airplane started to veer to the right. The pilot applied left rudder, but the airplane continued to veer to the right. The right main landing gear lifted off the ground and the airplane collided with a snow bank. The airplane flipped over, both wings and the vertical stabilizer were damaged. The most recent weather observation (about 22 minutes prior to the accident) reported winds from 90 degrees at five knots.

Saturday, February 01, 2003**Kenai, AK****Cessna 150, N704JB****2 Uninjured.**

At about 2:00 pm the airplane overran the runway and collided with a snow berm at the Trading Bay Airport. The private pilot and passenger, were not injured. Conditions were VFR. The flight originated at Johnson's Airstrip, Kenai, about 11:30. The pilot reported that he overflew the airport and saw another airplane parked on

the north end of the runway. The runway is oriented north/south, and is about 4,200 feet long. The pilot observed what he thought was a coating of gravel on the runway and decided to land toward the south, beyond the parked airplane. The pilot later estimated there was a 8 knot tailwind. The airplane touched down just beyond the half-way point on the runway. When the pilot applied brakes the airplane began to slide sideways and the pilot realized the runway surface was glazed with ice. The left main landing gear collided with a snow berm, damaging the gear attach point. The upper surface of the left wingtip was also slightly damaged.

Sunday, February 09, 2003

Lockhart, TX

Cessna 152, N25324

1 Minor Injury.

At about 11:16 am the student pilot lost control of the airplane during landing at Lockhart Municipal Airport. The solo student pilot received minor injuries. Conditions were VFR. According to an FAA inspector, the student pilot was on his first solo flight performing touch and go landings. As the airplane touched down, it immediately veered left off the runway onto grass, became slightly airborne, and struck a small house, resulting in structural damage. The house was located just off airport property.

Saturday, February 22, 2003

Rome, GA

Cessna 150, N8115F

2 Uninjured.

At 1:20 pm the airplane collided with trees seven miles west of Russell Airport. Conditions were VFR. The CFI and student pilot were not injured but the airplane received substantial damage. The training flight originated from the Russell Airport twenty minutes prior to the accident. According to the CFI, the student pilot was practicing emergency procedures and had been instructed to power back to idle and look for a place to land. When the CFI instructed the student to restore engine power the engine only developed about 1,900 RPM. The CFI took control of the airplane and applied carburetor heat. The engine rpm decreased to 1000 rpm, and the carburetor heat was turned off. Unable to maintain altitude, the CFI made a forced landing on a golf course. The airplane collided with trees during the landing. The right wing was nearly torn off the airplane, and the left wing was badly damaged.

Tuesday, February 25, 2003

Williamson, NY

Cessna 150J, N51126

1 Uninjured.

At 11:50 am the airplane was substantially damaged during a takeoff from Williamson-Sodus Airport. The private pilot was not injured. Conditions were VFR. The pilot reported he intended to practice touch-and-go's at Williamson. It was a "gray day" and about 3 inches of new snow had just fallen at the airport. When he taxied onto the runway, the pilot could not see the centerline due to the snow coverage. He applied full power for the takeoff. During the takeoff roll, the airplane's left main landing gear caught the edge of a snow bank, and the airplane veered off the left side of the runway. The pilot reported that he was unaware of his position to the left of the runway centerline during the takeoff, and that this was the first time he had taken off with fresh snow covering the runway. The pilot reported about 160 hours of total flight time, 4 of which were in make and model. He had recently received a checkout in the airplane; however, this was his first flight without an instructor. Examination of the airplane by an FAA inspector revealed substantial damage to the left wing, rudder, and propeller.

Friday, February 28, 2003

Columbus, OH

Cessna 152, N170SU

2 Uninjured.

At 11:21 am the airplane was substantially damaged by landing short of the runway at Ohio State University Airport. The CFI and student pilot were not injured. Conditions were VFR. According to the CFI, they had been performing touch and go landings to runway 27R, which is 2,994 feet long and 100 feet wide. During the accident approach, the student had set 20 degrees of flaps and established 62 knots of indicated airspeed. The CFI observed the airplane descend below the "glidepath," and instructed the student to add power. After a few seconds, the student added about 50 rpms of power, and the CFI told the student to add more power. When the student didn't respond, the CFI attempted to add power himself; however, the student's hand remained over the throttle, and the CFI was unable to add power. The CFI then started to flare the airplane for landing. The airplane touched down about 20 feet prior to the runway in snow, where it pitched forward on its nose, and the nose gear collapsed. The airplane came to rest about 30 feet beyond the approach end of the runway. Calm winds were reported at the time of the accident.



Member Classifieds

Ad of the Month : For Sale



1976-150M 2,100TT 300SMOH SHOWROOM QUALITY - w/ new millennium cylinders, slick mags and color coded wiring harnesses. Annual done 4/03. New Paint, New interior including all plastic, carpet, seats and glass. Horton STOL kit with stall fences. New Panel Mount Garmin 250XL Moving Map GPS, New Garmin 320 Transponder, New intercom, New ELT. Northstar loran. PTT yoke. Wing tip strobes. No damage history. No corrosion. All logs meticulous and detailed. Never a trainer, always privately owned and hangared since new. Many extras included. Restored to showroom condition. Tony (904) 583-8383 Anthony.Decrosta@anheuser-busch.com \$35,000 OBO (Florida)

About our Classifieds: These ads are updated daily on our website. Ads in this edition were current as of June 18, 2003.

Rates: Classified Advertising is free for all Cessna 150-152 club members. The Non member rate is \$20 per ad, per issue and includes 60 days of advertising on the website.

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The Cessna 150-152 Club
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A Blast from the Past...

Periodicals Postage
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SO LO!

Some thoughts
 of a St. Louis
 businessman
 the day he
 made his first
 solo flight
 in a Cessna:



Q: "I remember... I was in the East looking for a job... I was off by himself."



He had had... I was in the East looking for a job... I was off by himself."



And he had... I was in the East looking for a job... I was off by himself."



That's a good... I was in the East looking for a job... I was off by himself."



Yes... I was in the East looking for a job... I was off by himself."



Don't... I was in the East looking for a job... I was off by himself."



You have... I was in the East looking for a job... I was off by himself."



That's a good... I was in the East looking for a job... I was off by himself."



Yes... I was in the East looking for a job... I was off by himself."



Don't... I was in the East looking for a job... I was off by himself."

An old tradition with flyers is to cut off your shirttail when you solo. Cessna dealers then place the cloth with your name in a commemorative trophy for your home or office.

"When you start," invariably was the first question my non-flying friends asked when I told them I had soloed. And the answer was: "No." I had expected to be nervous, but actually I was too busy making sure I wouldn't embarrass myself with a beauty landing or something.

You see, your instructor won't let you solo until you're fully capable. Besides that, modern planes are very forgiving of mistakes, especially a Cessna—which I learned in. For example, its 360-degree gives you extra lift and stability. And rounded wing windows, there's even a wrap-around back window, you get extra stability around and down. Another as the huge flap. If you should come in high for a landing, you simply lower the

flaps and four right down. The landing gear lets you practically drive onto the strip. It's spring steel, so it absorbs and your landing gear helps you correct misjudgments you might make at first. (Cessna calls it "A-1-A-1-0-1-0-1-0-1" and all this means is that you haven't anything more serious to worry about than a little falling if you go off.

Best of all, it doesn't take long to learn. I was in my seventh hour of instruction when I soloed. (I'm not bragging; a couple friends of mine even did it in less time.) Now with a student's license, I go up alone to practice. I get a big kick out of that. And in a few weeks, I'll get my private ticket. Then I can take passengers. That's when the fun really begins.

The next step after learning to fly... is to get a plane. How many are there now? (I'm not bragging; a couple friends of mine even did it in less time.) Now with a student's license, I go up alone to practice. I get a big kick out of that. And in a few weeks, I'll get my private ticket. Then I can take passengers. That's when the fun really begins.

So take the first step now... or your Cessna dealer about flying lessons. In the meantime, for a few days of Pre-flight First to solo, you about how and why an airplane flies, write: Cessna Aircraft Company, Dept. F-21, Wichita, Kansas.



CESSNA'S SPIRITED LOW-PRICED TRIO

Now the New Cessna 150 brings 1400 Gross Weight to the lowest price Cessna. Winchows all around, give you the added safety or greater fuel and flight visibility plus the sleek new look of a spirited sports car.

Power to Match the Swift New Look is yours with the 100 hp engine that delivers top speeds up to 125 mph... 1400 lbs... 360 miles... service ceiling 12,650 feet.

Three 150 Models to fit your two-place needs: the low-priced Standard, \$7,825; the dual-engine, Fuel Tank, \$8,825; the deluxe equipped, Turbine, \$9,425. (Optional, new pilot, bus, passenger or sportsman, there's a 150 for you.



Put the Fun Back Into Travel with the hip, roomy Skyhawk. Many comfort and beauty extras as standard equipment include speed wheel fairings, even all paint, a full complement of light instruments, machine bucket seats, and dozens of luxurious convenience items. Here is a full sized four passenger plane that you can fly which your automobile travel allows... \$12,200.