sugarbushsoaring.com

Sugarbush Soaring – *The Flight Line*

2355 Airport Road, Warren, VT 05674 (802) 496-2290
Volume 35 Number 1 May 2018

OPENING DAY ANNOUNCEMENT

Our opening day is Saturday, May 19th. There will be a safety meeting at 9:00 am, followed by any remaining glider assembly and general field preparations for the season. Please make every effort to attend, and please also join us for dinner at 5:30 at Mad River Glen's General Stark Pub.

WELCOME
Welcome back to the 41st season of Sugarbush Soaring. I am very excited about what's in store for 2018 and have several updates for you:

Personnel
Tom Anderson will be returning as the full-time Director of Operations for the airport and for Sugarbush Soaring. In addition, you'll be seeing more of Jen Stamp, who will be working as an instructor multiple days per week (instead of just Sundays). Jen will also serve as volunteer coordinator. Both bring tremendous enthusiasm and commitment to our organization. The new content on our web site is thanks to their hard work. They have also been instrumental in creating a new business plan and helping our Board of Directors plan for the future.

Fleet
A brand-new PW-6 (N777VT) will be arriving shortly after opening day, and we will also have our beloved 2-33 Miss Daisy (N2743H) back in action by opening day.

Programming
Due to strong demand, we will run three youth camps this summer (July 8-14, July 22-28, and August 5-11). We will also run two VTC/VFA (Vermont Technical College / Vermont Flight Academy) day camps on July 31st and August 3rd. The FEFY (Flight Experience for Youth) Airport Day was a complete success last year, so FEFY will sponsor another day this year on June 3rd.

Rick Hanson will host a "Wings and Wheels" day in September. Look for an announcement of the exact date, and Tom and Jen have been working with Mad River Valley Television and several of our line crew and youth members to put together a documentary chronicling the long history of soaring in the Mad River Valley. The interviews and information gathered so far have been fascinating, impressive and at times quite funny. I'm sure we'll all be delighted with the results.

Facilities
Tom Emory and I have worked over the winter to transition to a new Square-based point of sale system for our office. Simultaneously several of us have been planning to partially renovate the first floor of the terminal building (volunteers may be needed). Both of these efforts are focused around making our office a more welcoming and modern environment. Longer term, Steve Platt, Fritz Horton and Bill Newell have been working with noted architect David Sellars on a design for a new terminal building.

Membership
Nineteen new members joined us in 2017. Please welcome and introduce yourself to any of these members who you haven't met:
Full Members: Steve Avery, Patrick Campbell, Donald Chamberlain, Andrew Churchill, Jose Hoyo, Warren Nichols and Tom Schinkel
Twenties Member**:** Ross Altman
Student Members: Hengnui Liue and Payton Veillieux
Youth Members: Lucas Allraum, Alex Chudzik, Will Drody, Patrick Jackson, Quincy Payne, Silas Scheckel, Josh Seckler, Kevin Seery and Sonia Talarek

Please fly often this year, volunteer to help when you're able, and make every effort to attend our safety meetings.
I look forward to seeing you all at the field!

Carl Johnson
President

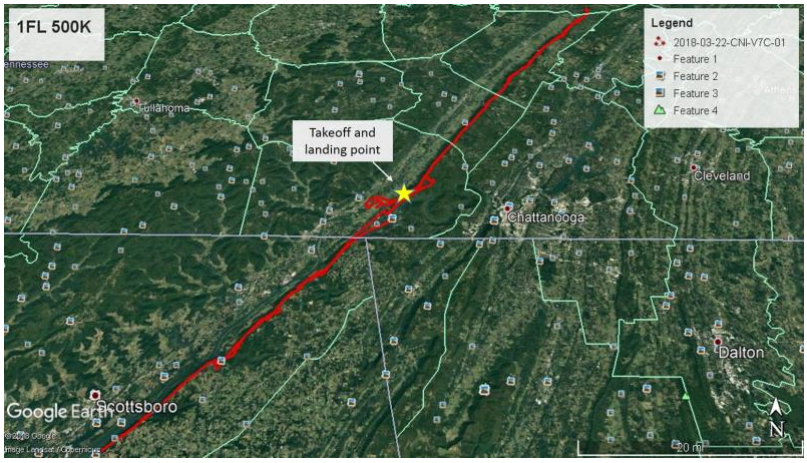
Diamond Badge the Sequatchie Way or How Not to Fly a 500 K
By Tim Larsen

I missed the turn points by *how much?*
It was always my desire to complete my Diamond Badge with all three legs east of the Mississippi. I made my 5000 meter climb in West Virginia and my 300k at Cordele, Ga. That was over a decade ago. Since then the stars had not aligned for me to get in a 500K distance task. I did it in West Texas, but I chose not to claim that. So after two years of rain and wrong winds, this was my year at the Sequachie ridge camp in Tennessee. The Sequatchie Valley is a 62 mile trench through the Cumberland Plateau north and west of Chattanooga. It is 1500' on the sides and 5 miles wide. It's one of the best ridge sites in the country. To the south, after crossing the Tennessee River, the ridge picks up again in Alabama and follows the east bank of the river until it fizzles out at Gadsden. Several record ridge flights from Pennsylvania have ended there.

The valley is aligned exactly as ours at Sugarbush, so a post frontal NW wind is ideal. My day came on March 21, day 1 of the camp, with snow in Nashville, 30 knots onto the ridge, and snow showers and low ceilings at the north turn point near the Hinch Mountain VOR. I took off from Marion Co. airport around 11:30 am and after release headed straight for the start sector at the quarry at the southern end of the ridge. From there, nose down, 100 knots (no water, too cold), and off to the races. A glider ahead of me reported the ceilings were at ridge top height. The southern half was blue, so I hoped for improvement and carried on.

The ridge was pretty rough. Every spec of dirt in my cockpit was in my face at some point. Water would have been very nice to have this day. At least the CZ has very flexible wings to absorb some of the bumps. 60 miles and a few snow showers later, I turned the Hinch Mt sector (or so I thought) and rocketed to the south. I couldn't actually see the VOR since I was below it and it was in the cloud. The visibility was good enough however, so I wasn't concerned. Only 95 miles to go for the southern turn at Scottsboro, Al.

Unfortunately, by the time I reached the transition to thermalling across the river, the conditions weren't quite ready with the winds kicking up and no cu's. I decided to restart the task and hope for better thermals when I got back here again. Back on the ridge I made it 40 miles and then heard another pirep telling me the conditions deteriorated at the north end. So, then it was back to the river and continue on with the first start, albeit with an 80-mile detour. The thermals must be better now. I made it to Scottsboro, carefully. The ridge goes from being a mile from the river to being *on* the river. If things went south, it would require crossing the river to get to fields. Fortunately, the wind and the thermals cooperated. I turned at Scottsboro (I thought) and headed back north for the 95 miles back to the VOR. The reports said the conditions were about like they were the first time I was there, so on I went, crossed the river, back to the ridge, and again rocketed up to the invisible VOR. I turned when my Oudie told me and headed south to the finish at the quarry. 6 hours later I was back on the ground with diamonds dancing in my head – at last! Plane tied down, beers all around, what a glider god... Then I looked at my downloaded trace.
It turns out since my map was zoomed out so much I couldn't see that all three turn points were programmed as cylinders instead of FAI pie sectors. My Oudie was telling me to turn when I entered the cylinders – literally meters *too soon!* The flight was invalid. What a rookie mistake. There was only one thing to do. Do the flight again!



I was very lucky (which is always better than being good). March 22 arrived with NW winds again. Not quite as rowdy, only 12 to15knts but still sufficient for another ridge run. The low ceilings and snow had moved on and cu's came when needed. This time the computer was programmed correctly, and I made sure to fly farther into the sectors for insurance. Fast forward to a successfully flown identical task, and again, smiles all around, beers popped, and traces downloaded. Only one problem. My Nano did not record the flight! That's okay, I still have my FLARM and my ClearNav loggers for backups. Well, the FLARM GPS glitched before I turned at Scottsboro and started up again after. No good. I had to reboot the ClearNav during the flight, so I figured that trace was also no good. Three loggers, three failures! This could not be happening! Out of desperation, I downloaded the ClearNav trace. Unbelievably, except for a 30 second gap, the trace was continuous. We have a winner! 502K at 70 mph. Not bad considering I had to slow down on the ridge due to the lighter winds. So, two days, two 500K flights. One Diamond Badge completed. The rest of the camp was not soarable.

Thank you, Mother Nature.

Pilot Accomplishments

There were a number of accomplishments by SSA members over the past year that we'd like to acknowledge. These include FAA pilot certificates, first solos, SSA badges, branching out to new types of aircraft and/or showing a strong commitment to making him or herself a better pilot. Notably (but not all inclusive) we'd like to acknowledge the following –

Peter Halfinger earned his Private Pilot Glider certificate early last season. He now owns and flies a Stemme S6-RT.

Alex Scaperotta, shown here with DPE Bill Stinson, earned his Commercial Pilot Glider certificate last August. Alex was the recipient of the 2017 FEFY Advanced Scholarship, which helped cover the cost of his training. Alex is a former SSA Line Crew member who is currently studying engineering at Tufts University in Boston.

Stephen Hausrath soloed last year. Stephen has attended two SSA YSCs and is a SSA Youth Member from Plattsburgh, NY. He will be a junior counselor at one of this year's YSCs. Pictured here (from left to right) are Rick Hanson, Stephen, Jen Stamp and Tom.

Jackson Markow passed his Private Pilot Glider checkride on a very windy day last October. Jackson is finishing his senior year at Montpelier High School and will be heading to the University of Southern California in mid-August, where he plans to major in either Aerospace or Astronautical Engineering. He has been a SSA Line Crew member since 2014 and is the recipient of FEFY's 2018 Advanced Scholarship, which he will use towards his Commercial Pilot Glider certificate this summer.

Lucas Allraum soloed last summer (he is shown here with Tom Anderson, who was busy performing shirt-cuttings last year). Lucas has attended several SSA Youth Soaring Camps (YSCs), is a SSA Youth Member and will be attending a YSC this year. Lucas lives in Miami, FL and spends part of the year in Stowe, VT.

Pilot Accomplishments continued…

Ryan Dessureau is one of our SSA Line Crew members. Ryan had two goals for last season and achieved them both – 1) solo in the SGS 2-33; and 2) solo in the SGS 1-26. Ryan lives in Waterbury, VT and is finishing his junior year at Harwood High School. He plans to pursue a career in aviation.

Quincy Payne has attended two SSA YSCs and is a SSA Youth Member from Lincoln, MA. He came up for a long weekend last September and soloed. Quincy will be returning to 0B7 for one of this year's YSCs.

Bill Newell started flying power planes recently. Last summer he soloed in his new Aerotrek A220. Bill also owns and flies a HpH 304-C.

Other noteworthy pilot accomplishments:

- One of our instructors, Tim Larsen, earned his Diamond distance (500 km) soaring badge in Tennessee. Also, after a 40+ year hiatus, Tim started flying power planes last year and is now a part owner in a 1941 Taylorcraft.
- Bill Newell soloed his new power plane, an Aerotrek A220. Rick Hanson performed his training.
- Paul Kram was recognized as SSA's Most Improved Pilot at last year's closing dinner. Paul was one of our most active members last year, flying regularly in his glider as well as with Rick Hanson in the Taylorcraft.
- Ian Clarke, a former SSA Line Crew member, started giving commercial rides for SSA last year and is currently working on his Certified Flight Instructor Glider (CFI-G) certificate. He is a student at the University of Vermont.

SSA Volunteer Program - 2018 Season
by Tom Anderson

SSA is in a time of transition. Some of our key long-time, dedicated volunteers who have contributed heavily and borne the load for SSA in various roles are stepping back or moving on. To help fill this gap, SSA is looking for additional involvement from a wider range of members.

Why does SSA need this?

- Volunteerism is very important to the health and vitality of our organization. It enhances the atmosphere at the airport and builds a sense of teamwork/cohesion.
- Giving members formal avenues via which to contribute empowers them and allows them to take ownership.
- We need the help! Quality, directed help will reduce staffing costs and burnout.

There are a number of things that club members can do to help right away -

- **Make people feel welcome**! Our increase of 19 total new members (10 adult and 9 youth members) last season tells us that you all are doing a great job in making folks feel like they belong. Believe it or not, this is probably the most valuable and underrated thing that can be achieved by all of our members/staff. This requires no special skill sets other than a smile, passion for the organization/sport and a willingness to share. Nationwide and in the sport of soaring in particular, the number of pilots is going down. Please help us buck this trend and keep our operation sustainable and growing.
- **Educate the prospect and let them know this can be fun, attainable, challenging and rewarding**. Remember - any new environment, especially aviation, can be daunting and overwhelming for someone who is unfamiliar with its jargon, acronyms, and activities.
- **Introduce potential new members to the staff**. If you are at the gazebo and the SSA staff are busy, please don't assume the staff have met the prospect who you are talking with. Please make a point to introduce them to key people and help them along their path to membership, lessons, rides, youth programs – whatever they are looking for.
- **Volunteer to help with the tasks listed below.** Sign up and list your skill sets and/or what you are willing to commit to. Remember - you don't have to be physically present or have any highly technical skill sets to contribute. We have a lot of needs across the spectrum.
- **Participate in SSA activities.** Attend the monthly Safety Meetings, attend social events, come fly.
- **Encourage your fellow members to participate.**
- **Say thanks** to the people who donate many hours of their time. Our 'super volunteers' work tirelessly doing many tasks (a number of which are not glamorous) to make SSA run.

Jen Stamp has offered to take on the role of Volunteer Coordinator to help direct and facilitate volunteer efforts. She has started to develop lists of volunteer opportunities and needs for the 2018 season. Below are some of the tasks we are seeking assistance with for the 2018 season. If you are interested in volunteering, please email her at volunteer@sugarbushsoaring.com.

- Mowing
  - Office (push mower, weed whacker). This year we will keep a push mower and weed whacker in the basement of the office to make this task easier.
  - Runways (reel mowers)
  - Brushhogging
- Trailer maintenance
  - The Grob 102 trailer needs to be rebuilt. Others may need work as well.
- Airport facilities
  - Re-shingle the Rwy 22 gazebo
  - Spruce up the second floor of the Tower building (paint, new furniture)
- Running the line when school is in session and Line Crew are not available
- 'Comfort' committee
  - We have a nice new TV but not a comfortable place to watch it from (youth campers end up lying on the floor to watch movies in the evenings!). Can we find couches or more comfortable furniture for the second floor?
  - Picnic tables (monitor condition, fix as needed)
  - Add more comfortable seating options for visitors on both ends (Rwy 22 and Rwy 4) (some ride customers have requested this)
- Volunteer for the social committee
- Send Carl Johnson photos and stories for social media releases

We are seeking volunteers to help rebuild the Grob 102 trailer.

We are always looking for volunteers to help with mowing!

Volunteer spotlights

Bob Bodecker has taken on golf cart maintenance. Remember the white cart that wouldn't run? Bob fixed it and saved us a lot of money. He has his sights set on the 'Frog' (our green cart) next. Bob is also training the Line Crew on basic maintenance and will be instituting a golf cart maintenance tracking program. Thanks Bob!

As you can tell, the golf carts are critical to our operation. They serve many uses.

Ron Webster 'Super Volunteer'. For as long as many of us can remember, when something broke, needed repair or needed to be built, a small motorcycle would be seen heading across the airport to the Sugarbush hangar. With quiet assurance, Ron Webster was always willing and more than able to perform any task needed. He personifies the "Super Volunteer" title. It didn't matter to him if it was building picnic tables, rebuilding our road signs or using his amazing skills and machine shop to manufacture a part. It was clearly a labor of love. Ron would look at the complicated and no longer available part that was broken, say something about being back in a while, and would then return with an exquisite, precise and perfectly fitting part. He can fix anything, make parts out of "unobtainium" and in many cases, improve of the original part. Ron is always willing to share his vast aviation knowledge and help fellow pilots learn the ropes of soaring. Ron put a lot of effort into the governance of the club and is always so generous with his time and management acumen. He is a truly great ambassador of aviation, Sugarbush Soaring, the airport and our community. Thank you so much Ron, for all the big and little things you do to make us stronger and functional.

Ron Webster has been a 'Super Volunteer' for SSA for many years. Thank you so much Ron, for all the big and little things you do!

Documentary on the History of 0B7
by Jen Stamp

This past winter I started working with Tom Anderson and three of our senior Line Crew members (Nick Colwell, Jackson Markow and Ryan Dessureau) on a documentary on the history of 0B7. Our goal is to capture the history through the eyes of long-time members of the 0B7 community. We have conducted seven interviews so far, with more planned for the summer. We've been conducting the interviews at the Mad River Valley Television (MRVTV; www.mrvtv.com) studio in Waitsfield with assistance from Tony Italiano, who has been a great teacher. MRVTV has graciously been loaning us audio and video equipment free of charge, along with studio space.

The Line Crew have greatly enjoyed the interviews. They are the ones asking the questions and running the camera and sound equipment, and are becoming more comfortable and skilled with each interview. The documentary has also provided them with a great opportunity to meet and get to know club members who they otherwise may not cross paths with. They have also gleaned some great life and flying lessons from the interviews, in particular from the question they ask at the end: 'if you had one thing to pass along to me and my fellow Line Crew members, what would it be?'

Over the summer we will continue conducting interviews and collecting video footage and photos. We may also take a road trip to Maine to interview John Macone, one of the founders of 0B7. One thing we have noticed is that photos from years before cell phones are much harder to come by. If you have photos or videos that you think would be a good fit for the documentary, we'd greatly appreciate it if you could contact us at photos@sugarbushsoaring.com and let us know what you have. Ideally, we're hoping contributors can scan their photos and email them to us but if that isn't feasible, please contact us and we'll figure out the best way to obtain the files.

This is a volunteer effort, so we're chipping away at this as our schedules permit (on the side of school, jobs, SATs, etc.). By next winter we hope to have gathered all the footage and will focus on the editing. Right now we're envisioning a number of different 'episodes', including segments on airport infrastructure (runway, Tower building, hangars), operations (who has run the soaring and tow operations over the years), soaring competitions, air shows and Youth Programs. While those will be relatively short snippets, we plan to keep copies of the full interviews as well, as they contain great stories about 0B7, soaring, interesting characters from 'Mascara Mountain' and the Valley. So if you see us around the airport this summer with video cameras, you'll know what we're up to!

In early April, we conducted an interview at the MRVTV studio with Jim Parker Sr. who is shown here with Jackson Markow, Nick Colwell and Tony Italiano.

WATCHING IT SNOW

Winter, in Vermont or wherever you may be this winter, so far, has been a mixed bag – snow, rain, ice, temps in the single digits followed by wind, rain, sun, and temps in the 50's. At times the skiing was better in Atlanta than in Vermont (only the ski areas are rare in Georgia). Global unpredictability more than global warming, it seems. It's mid-February and I am sitting at the computer next to an iced-up window in Colorado – it was in the mid-60's yesterday; the local outdoor town tennis courts were busy all day yesterday. Today you could ice skate on the courts. Hmmm. I got thinking that this is a good reminder that there are some things we cannot predict, some things that we cannot change, some things that we must be prepared for, and some things that will go wrong.

A beautiful Vermont morning. Lots of sun. Lenticular clouds, churning rotor cloud indicating wave with the primary right over the ski area parking lot – what could possibly go wrong!? Or a wonderful, warm summer afternoon. Some beautiful streets that seem to go to the horizon – It's obviously a fantastic thermal day and getting stronger as the day goes on! Let's go!

Okay – but let's not forget some important things before we fly. Check the forecast – what you see may not be what is in store for later when you are miles from the airport when the winds pick up, the front comes through, or the thunderstorms building over the Adirondacks quickly move into the valley.

Check the winds aloft – maybe that mountain wave is so strong that the turbulence aloft is beyond what you or the aircraft can tolerate. Check with the tow pilot and others who have already flown – maybe the turbulence or cross- wind in the pattern is beyond your comfort level. Prepare for the flight – be sure that you are: current and capable of dealing with the conditions that not only exist, but MAY occur during your flight.

Make sure you are rested, not stressed about work or other problems, and hydrated. Remember the great thing about soaring is that, in the air, there is no one telling you what to do – the sobering flip side of that is that, in the air, again there is no one telling you what to do.

"Do the right thing. It will gratify some people and astonish the rest." Mark Twain

- Rick Hanson

A TRIP TO K&L SOARING

Tom Anderson and Carl Johnson drove down to K&L Soaring on February 20th to drop off the rudder and vertical stabilizer from N33966 (our wind-damaged galactic thunderslug). K&L plans to use these pieces to save us some money on the 43H (Miss Daisy) repair. By the time you read this we expect to have Miss Daisy back on the field, but we thought you might like to see some pictures from that trip.

This is what 43H looked like back then. As you can see they removed the fabric from the rear fuselage and had already finished the repairs on the tubing. They again said that the fabric is in very good shape but has a few paint adhesion issues. We'll need to monitor this and reapply paint from time to time, but they expect that we'll get another ten years or more out of the fabric.

Here's a closeup of the major repair to the tubing. Note the doublers that have been added. Another oddity that Kyle pointed out was the copper tubing used to run the total energy probe line. They were amused to see this, and plan to replace it with plastic tubing.

Here Les is pointing out some cracks in one of the ailerons. It turns out that 43H is a hodgepodge of different parts that have been put together over the years. The wing serial numbers don't match the fuselage serial number, and the ailerons are a mix of up-to-date and older versions. This is the only aileron that doesn't have some extra doublers installed. These doublers became routine once it was discovered that the older ailerons were prone to kinking and cracking.

A closeup of the crack. Until Les discovered this, he remarked that this is the first time he'd ever seen an older aileron without the crack. They will repair this and install the doublers, bringing it up to date with the rest of the ailerons.

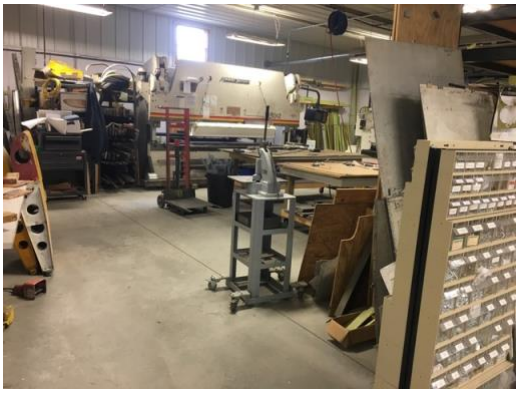
Here Kyle and Les are debating what do to about the kink in 966's rudder.

Les was worried that the rear aluminum might be cracked, which could potentially require a complete recovering of the rudder after the repair. They decided that they could cut a small slit in the fabric in order to inspect it. After determining that there was no cracking Les thought he could just pound the piece back into shape. Here he is banging it back into place. He seemed satisfied with the result.

Here's a closeup of the 966 rudder before Les removed the kink. One thing he also noted is that the rear line of the rudder is slightly curved - if you lay it flat the center of the rudder is about half an inch above the table. They determined that it wasn't worth fixing this, as it would also require a complete recovering of the rudder.

I didn't get any good pictures of the wings, but they had made great progress on those as well. They had already drilled holes for a new access panel and were going to add some doublers that are now standard. Kyle noted that the fittings that hold the top of the wing struts are likely rusted, so he recommended that they pull them, sand blast them, and reinstall them with new hardware. He said the cost to do this would be on the order of a few hundred dollars, so we gave them the go ahead.

A few more general shots of their operation:



Les was particularly excited to show us his rebuild of his father's 1950's vintage 1-31, which looks to be the ultimate tow plane. It's configured as a tail dragger tandem with a wide enough back seat to accommodate two passengers. There are fully dual controls, it has a 250HP engine for impressive climb performance, and Les says that it can descend at 10K ft/min. He'll designate his rebuild as a 1-31A and hopes to get FAA certification and put it in production, possibly as soon as 2019.

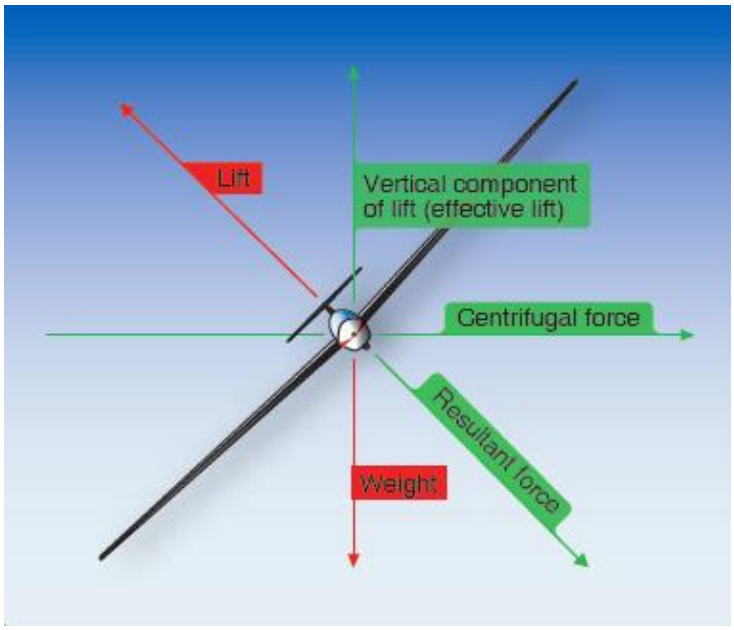
If you're ever in the Elmira area I recommend swinging by their operation. They couldn't have been friendlier, they have a clean and professional workspace, and they seem to be really good at what they do.

Carl Johnson

Glider Aerodynamics Puzzler #8 (Radius of Turn)

The Glider aerodynamics puzzler is intended to stimulate your thinking about soaring and refresh your understanding of glider aerodynamics and soaring optimization. The correct answers with detailed explanations follow the questions. Have fun.

Glider pilots are intimately familiar with optimizing straight and level flight depending upon the mission; ...ie. maximizing time aloft with flight at minimum sink speed; or, maximizing distance (optimizing energy) with flight at the best L/D speed adjusted for current headwind/tailwind and sink/lift; or, maximizing speed with flight at the appropriate MacCready speed. In all cases the optimum speed to fly (STF) for the particular mission must be adjusted for the current operating weight. Weight matters. What is less well understood is the effect of turning flight on glider performance.



In a coordinated turn some of the wings lift, the horizontal component of lift, is used to overcome centripetal force.

Specifically:
Horizontally component of lift = Lift * Sin(ang)
Centripetal force = W/g * V^2/R
Where ang = the angle of bank
W = the weight of the Glider
G = the acceleration of gravity (32.17 ft/sec^2)
V = the airspeed during the turn
R = The Radius of the turn
Equation 1: Lift* Sin(ang) = W/g * V^2/R

Figure 1

In coordinated flight the Vertical component of lift must continue to be equal to the weight of the Glider, so:
Vertical Component of Lift = Lift * Cos(ang)
Equation 2: W = Lift * Cos(ang)

These two simple equations solved for R (Radius of turn) results in a fundamental equation of flight for all gliders and all airplanes with wings (refer to Table 1 for the derivation):

Radius of Turn R = V^2 / (g * Tan(ang))

DERIVATION OF RADIUS OF TURN FORMULA

EQUATION 1:		Lift * Sin(ang) = (W/g) * (V^2 / R)
EQUATION 1	==>	Lift = (W/g) * (V^2/ (R * Sin(ang)))
EQUATION 2:		Lift * Cos(ang) = W
EQUATION 2	==>	Lift = W / Cos(ang)
Therefore:		W / Cos(ang) = (W/g) * (V^2/ (R * Sin(ang)))
	==>	R = (V^2 * Cos(ang)) / (g * Sin(ang))
	==>	R = V^2 / (g * Sin(ang)/ Cos(ang))
	==>	R = V^2 / (g * Tan(ang))

TABLE 1

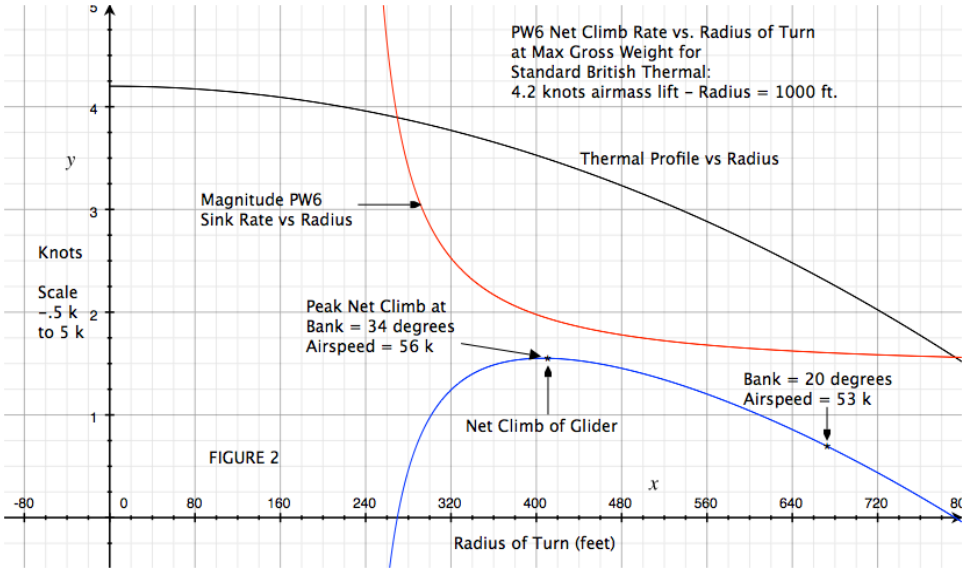
The radius of turn for ALL airplanes is equal to the square of the airspeed divided by the product of the acceleration of gravity times the Tangent of the angle of bank. The solution is independent of weight, and applies equally to a Boeing 777, and F16, or an ASK-21. Increasing speed and decreasing angle of bank in coordinated turning flight rapidly increases radius of turn. Conversely, decreasing airspeed and increasing the angle of bank rapidly decreases the radius of turn, and, unfortunately, rapidly increases glider sink rate. As the bank angle increases the total lift of the wing must increase.....ie.. the angle of attack of the wing and the corresponding load factor must increase to keep both the vertical component of lift equal to the weight of the airplane (plus the tail down force) ....and the horizontal component of lift equal to centripetal force. Increasing the angle of attack increases lift, increases the load factor, and increases drag.....and increases glider sink rate.

Why is all this useful to understand for Glider flight? For one, glider pilots spend a significant amount of time turning.....ie....thermaling. While thermaling the radius of turn matters. Too wide a radius of turn and the glider operates in the weakest part of the thermal or, worse case, circles the thermal. Too narrow a radius of turn and the sink rate increases rapidly more than offsetting the benefit of operating close to the core of the thermal. As noted in the Soaring Magazine May 2017 article "How to Optimize Thermaling Flight in Gliders", depending on the particular thermal strength and profile, the glider performance (especially the minimum sink speed and minimum sink rate), and, of course, how well centered the glider remains, there is an optimum bank angle and airspeed (radius of turn) to fly to maximize net climb performance.

QUESTION 1: You are planning to take your neighbor for a local glider flight in your club's medium performance PW6 glider (Best L/D = 34). Thermals have been reported as standard summer thermals ....ie...4.2 knots of airmass lift at the core decreasing parabolically to zero at a radius of 1000 feet. From a prior flight you know your passenger is a bit of a nervous flyer and does not like steep bank turns. You decide to limit your bank angle to 20 degrees while thermaling versus the optimum bank angle. If centered perfectly while thermaling, how much will net climb performance improve using the optimal angle of bank (and airspeed) versus 20 degrees of bank?

A. 10%
B. 15%
C. 25%
D. 50%
E. 100%

EXPLANATION: Refer to Figure 2. The Black line is the thermal strength profile versus radius from the core. The red line is the magnitude of the PW6's sink rate versus radius (ie. versus bank angle and airspeed) if flown at the minimum sink speed for each angle of bank. The blue line is the Net climb rate (Black line minus Red line). Notice that at 20 degrees of bank and an airspeed of 53 knots the radius of turn is 675 feet yielding a net climb rate of ~.75 knots. The peak net climb rate occurs with a bank angle of 34 degrees and an airspeed of 56 knots yielding a radius of turn of 410 feet and a net climb rate of ~1.5 knots. Therefore, the answer to question 1 is E. 100%. The net climb rate doubles at 34 degrees of bank and 56 knots versus 20 degrees of bank and 53 knots.



LESSON LEARNED: Radius of turn, and therefore bank angle and airspeed, matters. Using the optimum airspeed and bank angle while thermaling can substantially increase net climb performance. For most medium performance gliders the optimum angle of bank and airspeed to thermal at for Standard British thermals is ~35 degrees of bank at an airspeed of a 2-5 knots above the level flight minimum sink speed. In fact, in coordinated turning flight for ALL GLIDERS at Bank Angle X, the Minimum sink rate and the Minimum sink speed increase at the identical percentage rate factors relative to their level flight Min sink rate and Min sink speed.....given by the following equations ** and plotted in Figure 3.

(** Reference: The Complete Soaring Pilots Handbook, by Welch and Irving, 1977, Page 238, ISBN: 0-679-50718-3)

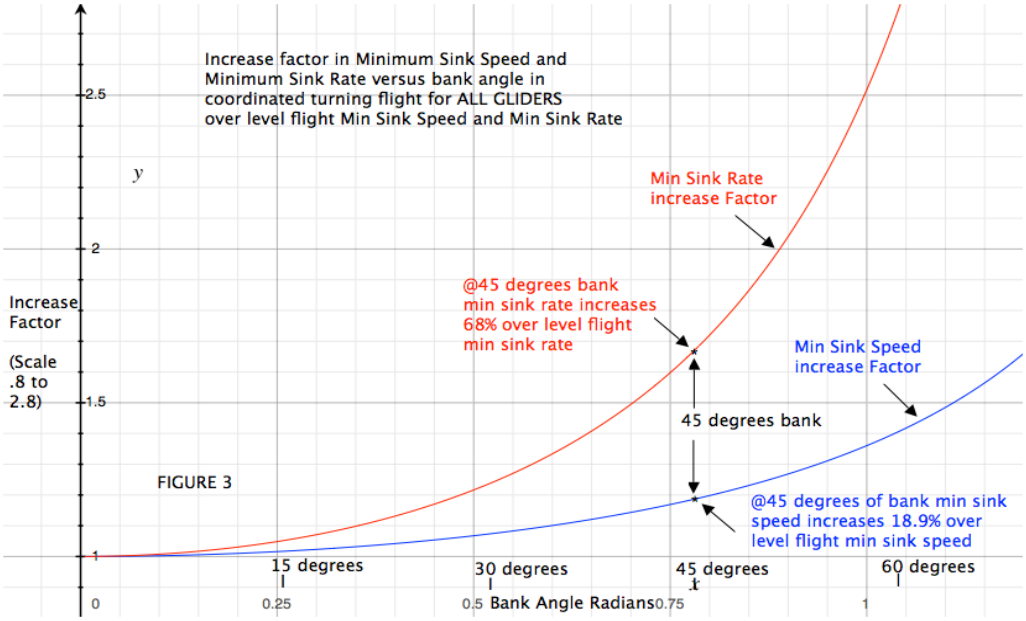


Figure 3

EQUATION 3: Min Sink Rate (@ bank angle X) = Min Sink Rate (Level Flight) * (1 / cosine(X))^1.5
EQUATION 4: Min Sink Speed (@ bank angle X) = Min Sink Speed (Level Flight) * (1 / cosine(X))^.5

Notice that at 45 degrees of bank in coordinated turning flight, the Min Sink speed increases 18.9% over the level flight Min sink speed.....and the Min Sink Rate increases by 68% over the level flight Min Sink Rate. For a PW6 (at gross weight) in a 45 degree banked turn, the Min Sink speed increases from 50 knots to ~ 59 knots and the Min Sink Rate increases from 148 ft/min. to 249 ft./min! The aerodynamics of thermaling is, indeed, fascinating.

Steve Platt