Making It Back To The Field

Kevin Price, CCSC Safety Officer

On local flights from CCSC, almost everyone makes it back to the field every time. Every now and then though someone lands unplanned at Red Stewart, ends up landing out of a straight-in versus a normal pattern and, on even rarer occasions, winds up landing short or in some farmer's field. Pilots use knowledge, experience, skills, judgment and a variety of techniques to remain within a safe and assured gliding distance back to CCSC. Rather than just "winging" it though, pilots would be well-served to quantify and define their personal guidelines for glide range so that they can avoid some embarrassment or, worse yet, a damaged aircraft which could include injuries. This is especially important for gliding in the Midwest where thermals are the primary and often the only source of lift.

DISCLAIMER: The discussion below is just that…a discussion. Any techniques, rules of thumb, etc., offered below are not intended to be guidelines that can be blindly followed with an expectation that you will arrive safe and sound back to CCSC. They are not hard and fast rules that will always work for you. They are based upon no wind conditions, the absence of sink, and assume you perfectly fly at L/D or a properly computed best speed to fly. (How likely are those assumptions?) Above all, you have to use your own judgment and air sense to make safe and proper decisions. In simple terms, I will offer up some thoughts and ideas, but in the end, you are on your own.

With the above out of the way, I will discuss the following methods by which you can determine if you should be able to make it back to the field. I will discuss each one separately.

1) Visual Cues

2) Altitude Required from a Reference Point

3) Glide Distance Calculation

4) Glide Computer

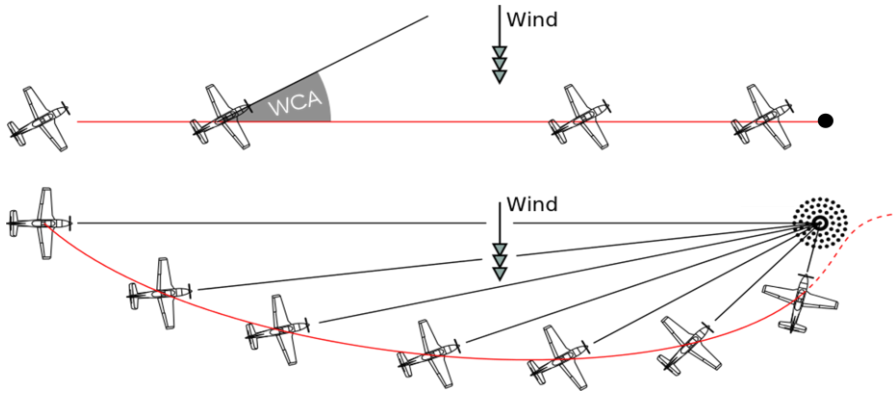
1) VISUAL CUES

If you are looking noticeably "down" at the airfield, you are almost assuredly high enough that gliding distance to the field should not be a concern. How far is "noticeably" down? It depends on how conservative you choose to be. Directly below you is 90 degrees and the horizon off your wingtip when wings level is 0 degrees. Even a 2-33 can normally glide easily to a point at a 10 degree lookdown angle to you. (A 10 degree lookdown angle to the field at 3 nautical miles will put you at about 3200 feet AGL.) There are no good cockpit or wing references to estimate such a shallow angle to the ground. Anything more than 10 degrees is very conservative, and lookdown angles of 20, 30 or more degrees fall into the "noticeably" down arena for which you can also start to use wing or wing strut references for angular estimation. Judgment on what angle can get you back to the field under various conditions

comes with experience. It would be very good though to backup that judgment with knowledge of the aircraft's performance and a little bit of math to assure you have it right. (I'll cover how do that later in this article.)

Another very useful visual cue is to fly toward the airfield and pay close attention to where the airfield is on the canopy and notice how that changes over time. Do not stare at the field as you fly toward it as it is harder that way to pick up a trend in the angular change. Rather, take a look, do a visual scan for traffic for say 15 seconds or so and then take another look. Repeat. What do you see? Is the airfield moving down the canopy? Good! Is the airfield staying in the same place on the canopy? Hum…keep an eye on it. Is the airfield moving up in the canopy? Not good! You likely aren't going to make the field unless you come across some lift, get out of excessive sink, or perhaps increase your glide speed by 1/2 the velocity of any headwind component. Alternatively, consider landing at a different airfield, especially if faced with a strong headwind. Keep in mind that turning in a direction to convert a headwind into a tailwind may result in opportunities to easily make airfields that are behind you.

Be aware of a subtle problem that can develop as you point at the field to fly home. If you have any crosswind component -- *which is almost always*-- pointing the nose directly at the field is not the shortest way back. The resultant homing effect results in a greater distance to fly. See below:



At glider speeds, drift from even a light cross wind can be quite significant which must be corrected with a crab angle in order to fly a straight line distance home. **Example**: At 60 knots true airspeed a 10 knot crosswind component requires 10 degrees of Wind Correction Angle (WCA), also known as crab*. So, be sure to crab when needed as you fly back to the field. Otherwise, your distance home will be longer, perhaps farther than you can fly. I find my flight computer is quite useful for providing me with an accurate wind correction angle when I am returning to the field.

* For an easy to use online E6B like calculator to determine the wind correction angle, go to http://www.csgnetwork.com/e6bcalc.html . There are also several other aviation related calculators on that page that can be quite useful. A simple and quite accurate rule of thumb for cross wind correction is to divide your crosswind component by your true airspeed in nautical miles per minute. A typical glider true airspeed of 60 knots equals 1 nautical mile per minute and so makes for easy math. Your wind correction angle would be 1 degree for each knot of crosswind, e.g., a 10 knot crosswind would require 10 knots of crab. A rule of thumb to calculate the crosswind component is to add to 20 to the relative wind angle and multiply that as a percentage by the wind speed. Example: A 25 knot wind is 40 degrees off your nose. Add 20 to 40 which gives 60. Make that .60 and multiply this value by the wind speed of 25. Your crosswind component is approximately 15 knots. This ROT is pretty accurate and works for angles 10 to 70 degrees off your nose.

2) ALTITUDE REQUIRED FROM A REFERENCE POINT

By familiarity and study of the local area you can readily know how far you are from the airfield. Through preplanning, you can compute the altitude required to make it home from easily recognizable geographic locations. The Lebanon Wal-Mart, I-71 bridge, Caesar Creek Reservoir Bridge at Harveysburg, and the northern edge of Waynesville city provide easily recognizable ground features that provide approximate 4 nautical mile (NM) reference points from CCSC.

So how high do you have to be to glide 4 NM and arrive at CCSC at pattern altitude? I won't get much into the math in this section, but for our aircraft the approximate **MINIMUM** altitudes you should consider for making it back to CCSC at a pattern altitude of 2000 feet MSL from the geographic locations above are as follows:

2-33: 3200' MSL (300' altitude loss per mile x 4 NM = 1200' lost)

ASK-21: 3000' MSL (250' altitude loss per mile x 4 NM = 1000' lost)

Grobs: 2800' MSL (200' altitude loss per mile X 4 NM = 800' lost)

3) GLIDE DISTANCE CALCULATION

Every glider has an advertised glide ratio. This glide ratio is theoretical. It is a perfect world number derived by modeling and analysis for no wind, no sink conditions in a perfectly flown, clean, straight, taped (if applicable) aircraft. Still, it is a metric by which you can compare performance among various gliders, and it provides a basis for developing a Rule-of-Thumb (ROT) for expected and conservative glide performance.

Based on your altitude above your desired arrival altitude you can calculate how far you can glide as well as how much altitude you will lose as you proceed back to the field. To ensure you remain within safe gliding distance to the field you need to know accurately know how far you are from the field. A flight computer can best help you determine exactly how far you are from the field. I use…and constantly common sense crosscheck…the range my flight computer provides to the field.

In the examples below I will use the nautical mile for the glide ranges. Why? The nautical mile is the standard for distance measurement in aviation, it is the basis for most aircraft airspeed indicators ("knot" is derived from "nautical"), and I just find it easier to work with a nautical mile. In the table below I rounded the nautical mile distance of 6076.12 feet down to 6000 feet for ease of math. (Dividing by 6,000 is easier for me than dividing by a statute mile distance of 5,280 feet --although you could argue for rounding 5,280 feet down to 5000.)

So, let's take a look at the published glide ratios for our CCSC aircraft and some applications thereof:

Aircraft	Glide Ratio	Glide Range per 1000' of altitude loss *	Altitude loss per NM	ROT Range Per 1000'	ROT Altitude Loss per NM
2-33	22:1	3.67 NM *	272'	3.0 NM	300'
ASK-21	34:1	5.67 NM	176'	4.0 NM **	250'
Grob 103	36.5:1	6.08 NM	164'	5.0 NM	200'
Grob 102	38:1	6.33 NM	158'	5.0 NM	200'

* Note on glide range computation: Per the 2-33's advertised glide ratio, at 1000 feet it can glide 22,000 feet. To determine how far 22,000 feet is in terms of a NM, divide it by 6000 feet. Result: 3.67 NM. So, a 2-33 is advertised to glide 3.67 NM for every 1000 feet of altitude loss. A shortcut way to compute glide range in nautical miles for any given glider is to divide the published glide ratio by 6. So, an aircraft with a 24:1 glide ratio will go 4 NM, one with a 54:1 glide ratio will go 9 NM, etc.

** While the ASK-21 should go nearly 6 NM per 1000 feet of altitude loss, in my personal experience I have noted as little as 4 NM per 1000 feet of altitude. I have seen this from a variety of headings on different days with varying winds. Could be just me…regardless, I use 4 NM per 1000 feet as my glide distance ROT in that aircraft.

The ROT glide ranges per 1000 feet of altitude loss were rounded down. Similarly, the ROT numbers for altitude loss per NM were rounded up. The ROT values are not exact but were rounded in a

conservative direction and to values that make multiplication easier. And, to reiterate a really really critical point, they are based on no wind, the absence of sink, and flying at L/D.

There are at least a couple of ways you can use this information:

1. Calculate <u>how far you can fly</u> based on your current altitude above your desired field arrival altitude and stay within that range

   <u>Example</u>

Desired arrival altitude:	2000' MSL
Current Altitude:	3500' MSL
Excess altitude :	1500'
Grob 102 Glide Distance ROT:	5 NM per 1000'
Range you can fly/ stay within range:	7.5 NM (5 NM x 1.5 = 7.5 NM)

2. Determine how much <u>altitude you will lose per NM</u> to determine your arrival altitude

   <u>Example</u>

Current Altitude	4000’ MSL
Distance from the field	8 NM
Grob 102 altitude loss per NM:	200'
Altitude loss to field:	1600' (8 x 200)
Arrival altitude:	4000' – 1600’ = 2400' MSL

I prefer to use option 1 above as it offers a quick way to determine how far I can glide. I simply ensure that my glide range to arrive at my desired altitude is greater than my current range to the field and keep it that way.

I find option 2 useful for determining a turn-around point when flying away from the field. By having a value for how much altitude I will lose per mile, I can assess how much altitude I will lose to return to the field at any point.

Whether you compute how far you can glide based on your current altitude or compute how much altitude you will lose over a certain range, keep in mind that these ROT's become increasingly unreliable the further you are away from the field. I would not recommend using these ROT’s for distances greater than 10 NM.

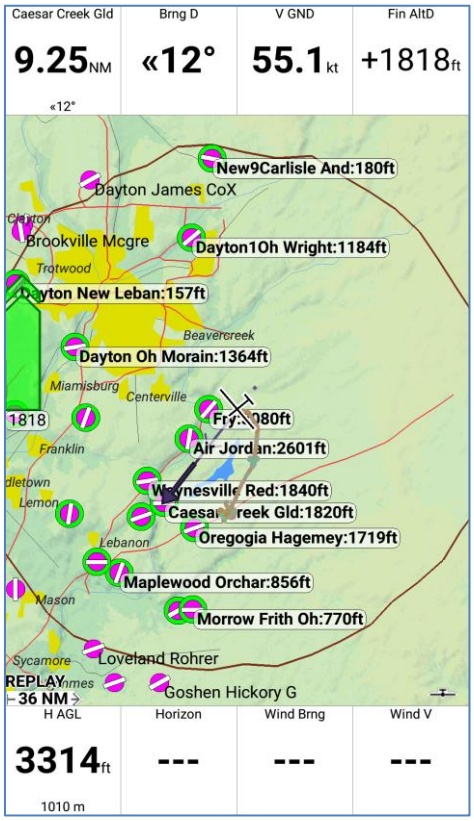
4) GLIDE COMPUTER

Today's glide computer software programs which run on our smartphones, tablets, PDA's etc are true marvels of technology. They can show us where we are over a moving map, our ground speed, our ground track, how far to the airfield, the winds aloft, depict controlled airspace, record our ground track,

etc. They can even **ESTIMATE** how far we can glide and what our arrival altitude will be at our destination based on the **CURRENT** wind and thermal conditions.

Notice the bolded, capitalized-for-emphasis words " **ESTIMATE "** and **"CURRENT"**? The glide computer cannot see ahead and account for sink or wind changes that lurk unseen in the distance. So, while a glide computer can certainly aid our decision processes and help protect us from mental errors, they must not be allowed to circumvent good judgment and a conservative approach to this gliding around business. The glide computer can also be in error due to a system problem (e.g., bad GPS track), a software bug, or even more likely an operator error of some sort (e.g., the selection of the wrong aircraft for polar performance, wrong desired arrival altitude input, etc).

I use the free open source XCSoar glide computer software on a Dell Streak 5" smartphone. (I do not need and do not have a cellular subscription service on the smartphone.) XCSoar does a really nice/accurate job of showing range to the field, position on a moving map, airspace, ground speed, winds (after a few 360 degree turns), a wind-corrected bearing to the field, an oval depicting glide range, a computed arrival altitude back to the field (Fin AltD), etc. I have found the computed arrival altitude to be a tad bit overly optimistic but it still is a good, reasonable reference for helping ensure arrival at my desired altitude back at the airfield. Below is a screen capture of XCSoar as I have it configured. Seemingly endless options exist for the information boxes…these are the ones that work best for me:



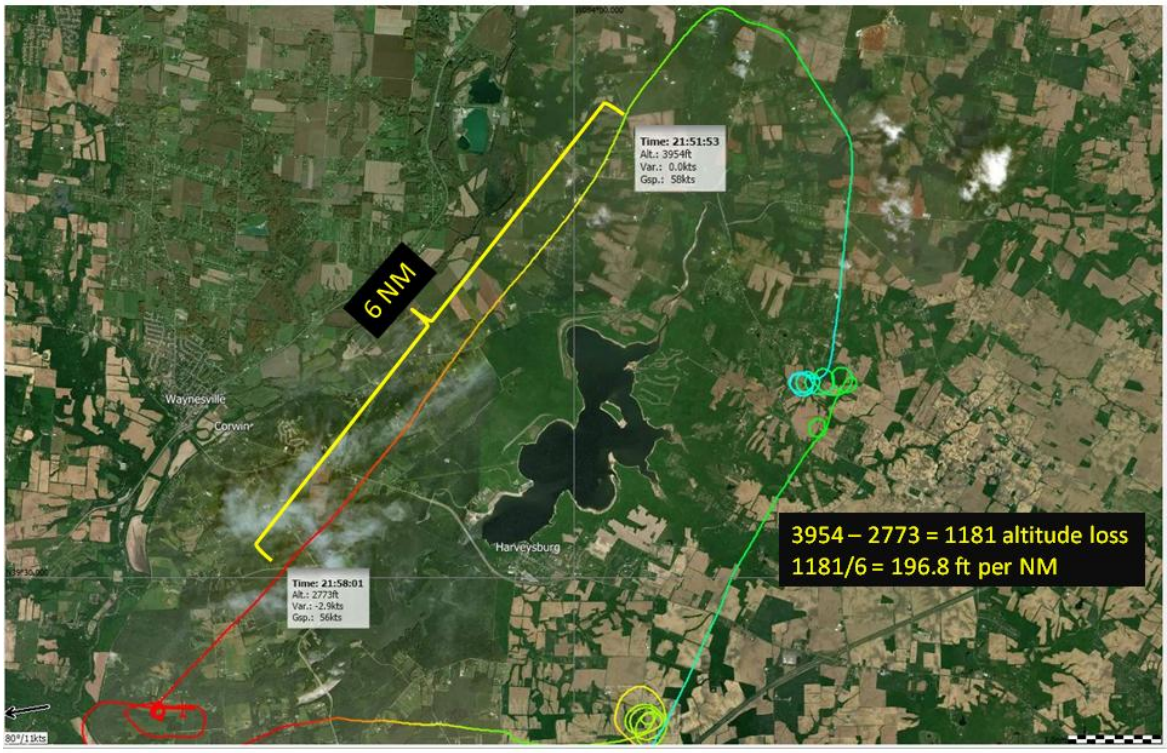
I do not by any means rely exclusively on my glide computer for determining how far away I am from the field, how far I can glide, and what altitude I will arrive at back at the field. I look outside and use all of the methods and techniques covered above along with my (still growing) experience flying gliders.

Keep in mind that just like the glide distance and altitude loss ROT's discussed above, the flight computer's estimate of how far you can glide or what your altitude will be upon arrival becomes increasingly unreliable the further you are away from the field. I would be very dubious about its estimates beyond 10 NM from the airfield.

POST FLIGHT ASSESSMENT OF GLIDE PERFORMANCE

With playback software, you can review your glide performance throughout your flight. I record all my flights with XCSoar and then review them with SeeYou. I recommend that you similarly review your flights with programs that work best for you.

Below is a flight I recently made where the winds aloft were nil as was the sink. It allowed to assess very well the glide performance of the Grob 102. I had a long straight leg back to CCSC and I took note of my altitude at 2 points separated by 6 NM. I took the altitude loss and divided it by the range to determine the altitude I lost per NM. The result was very, very close to the 200 foot altitude loss per NM ROT that I discussed above.



A NOTE ABOUT WINDS AND SINK

As I mentioned several times above, the techniques and methods I covered for determining glide performance are based on no wind and the absence of sink. While wind, sink, and thermals are always present when flying a glider, to factor those into the discussion I offered here would have defeated my objective of keeping this article simple and practical. As I close though I will offer a few thoughts on both wind and sink.

WIND: If you stay upwind, wind by definition will not negatively impact your ability to return to the airfield. However, there will be times when you intentionally or unintentionally find yourself facing a headwind. You could face a headwind intentionally based on where you chose to fly or get dropped off by the tow plane. You could face a headwind unintentionally based on where the tow pilot dropped you off without you paying attention.

You can also though encounter a headwind due to a change in wind speed and/or direction at altitude. Once at CCSC I went from a light southeast headwind on takeoff from runway 09 to a 35 knot southwest tailwind at altitude. (There was an approximate 100 degree shift in wind direction and a 30 knot increase in windspeed between the surface and 5000 feet AGL). Coincidently, unaware, and unfortunately I flew to the northeast with this wind as a direct tailwind for just over 4 minutes. In this brief period I almost flew too far from the field to make it back even from 4,000 feet AGL. Fortunately, I discovered the tailwind through a 360 degree turn to check things out before I got too far from the field. When I turned to the southwest to point at the field I noticed I had almost no groundspeed. Uh-oh. The key to making the field in this case was adding 1/2 the headwind component to my L/D. So, instead of flying back to the field at an L/D of 50 knots which would have given me a 15 knot ground speed, I returned at 65 knots which gave me a ground speed of about 30 knots. It worked. If I could not have made it, the best solution would have been to turn around and use that tailwind to easily get to the Greene County airport.

A headwind can make a very significant reduction in your glide range. Let's say your L/D is 50 knots and your no wind glide distance is 10 NM. Throw in a 10 knot headwind and you just reduced your ground speed by 20%. Guess what also got reduced by 20%? Your glide distance! So instead of being able to glide 10 NM you can now go just 8 NM. So pad your pad when faced with a headwind. And don't forget about increasing your glide speed by 1/2 the headwind component.

SINK: When there is great lift great sink is also lurking. If you plan on losing 200 feet per NM – which ***may*** roughly equate -2 knots on the variometer -- and assume you can fly 10 NM based on your current altitude, if you encounter an average sink of 400 feet per NM –which ***may*** roughly equate to -4 knots on the variometer -- your glide distance will be reduced by 50%*. So, instead of going 10 NM you can now go just 5 NM. What to do? Be sure you are flying at L/D so that you are getting the best range for altitude lost which will enable you to get out of the sink as soon as possible. One technique I have also heard is to turn 90 degrees to your current flight path until you get out of the excessive sink. The good news about excessive sink is that it is likely localized. You should be able to get out of it…and hopefully not with so much altitude loss that your return to the field is jeopardized.

* The vario may or may not roughly equate to altitude loss per nautical mile. The math and discussion for this are outside the scope of this paper. In our fiberglass aircraft though, a vario between -1.5 to -2.0 is typical/normal. If you are seeing -3 or more, you are in excessive sink and you need to adjust/plan accordingly.

The concern over winds and sink is the primary reason I reduced the ROT glide ranges and increased the altitudes lost per nautical mile from what the aircraft are advertised to do. Additional conservative adjustments are called for when conditions, your proficiency, or your comfort level so merit. Be sure to check the weather, winds aloft, the soaring forecast, and talk to any pilots that are flying or who have flown earlier in the day to gain the most understanding of the day's gliding conditions.

CONCLUSION

There are certainly additional means and methods to help ensure that you get to your desired destination in a glider. I have just found that the ones above work for me. If you think they are too conservative, too optimistic, or too hard to apply, use the ones you already have or develop your own. Above all, quantify and follow a plan to ensure you can always make it back for the potluck at CCSC.