BADGE FLYING PROCEDURAL BASICS

-or-

Filling the Squares

Submitted by Jim Wynhoff

This is not meant to be an all inclusive tutorial on flying for badges. The FAI Sporting code has *all* the information about all kinds of badge flights. If you can read the whole thing, and understand it all, explain it to me sometime. A lot of what follows is 'my take' on Badge flying. After that, there is a section taken from my correspondence with "The Badge Lady", and she's the one who approves or disapproves your claim.

Jim's take:

<u>Before even considering a badge flight</u>

I'm not even going to address using a barograph AND GPS receiver for proof of performance. Buy, beg, borrow, or steal a Certified Flight Recorder.

It's also a really good idea to go to the SSA website and download the Declaration, OO Checklist, and Badge Claim Forms. Reading through them beforehand may keep you from making an awesome flight that you don't get a badge for.

<u>Preparations</u>

As my friend Tony used to say: "Proper Prior Preparation Promotes Perfect Performance"

1. Make sure you have a current calibration for your Certified Flight Recorder (CFR). If not, send it to Craggy Aero, or Cumulus Soaring for calibration (there are other places to send them, but….) Yeah, I know you can get it calibrated after the flight, (within a short period of time) but if there's a mistake in the calibration (like the date) process, or anything else that causes a delay, you could be out of luck. Keep in mind that your Official Observer (OO) has to have a hard copy of the calibration sheet to perform the altitude compensation math required for badge claims. The calibration sheet is also one of the required documents to be submitted with the badge claim.

2. Put YOUR name in the CFR. Even if you make a paper declaration, (why would you?) you may not get a badge approved if the "Pilot Name" in the CFR isn't YOUR name.

3. Paper declarations are still allowed, but I don't think they are favored. If you decide to make a paper declaration, you should still at least change the 'Pilot Name' in the CFR to avoid problems.

4. Make sure the waypoints in your flight computer EXACTLY match those in your CFR. There are several different formats for Latitude/Longitude coordinates. Find out what your flight computer uses and make sure it equates EXACTLY to the turnpoints in your CFR (Some flight computer programs use DDD:MM:SS format, while some CFRs (Cambridge, for instance) use DDD:MM.MMM. One way to do this is to use GPS Babel to convert each waypoint file (from your CFR and from your flight computer) into Google Earth format (.kml) and then compare them in Google Earth. Zoom WAY in please.

5. Find a qualified and willing OO, absolutely before the flight, preferably before the Day of the flight. If you're really motivated, go to the SSA website and download and print the OO checklist, and the Badge Claim Form. Your OO is required to check some things (covered on the checklist) before your flight.

6. Go fly. But first… read the Badge Lady section below.

7. Flight considerations. In the Barograph days a 'Notch' in the Barogram trace indicated a start point. With CFR's the start of the soaring performance may be indicated by, Engine Noise Level (ENL), (noticeable even with aero tow, but not conclusive) a decrease in speed, turning radius, etc. Be nice to your OO. When you get off the rope, do at least one tight 360 to the right.

8. Of Starts, Finishes, Cylinders , and Sectors: Judy's guidance below is better than I can provide.

9. After the flight…Your OO must download your flight, or at least supervise (witness) the flight being downloaded from your CFR. From there, you, as the pilot are done, except for signing the badge claim form and providing input for various administrivia.

10. OO note: When doing the post-mission flight analysis, I think it's easier and more accurate to use Cambridge Aero Explorer (CAE) than See You for some data points, and See You does better with other points. CAE can be downloaded for free. One thing CAE does is display the Waypoints in the electronic declaration. These waypoints are contained in the .igc file, and are the Gospel. There's probably a way to make See You do this, but I'm not familiar with it.

11. The FAI Distance Calculator is available online, and is the standard for calculating leg distances. The format of waypoint coordinates in the .igc file is DDMM.MMM

Badge Lady Sez….

Sectors and Cylinders

Well, the Sector has been around 50+ years, and the Cylinder is quite a bit newer. It was first advanced in the mid-to late 1990's, when GPS pilots reported their software was best suited to telling them when they were within a certain radius of a given point. As a result, many US pilots lobbied vigorously for Cylinder OZs and they were adopted for contests several years before they became an alternative for badges & records. (It was 2001 or so before flight recorders started to become popular for badges; by 2004, photo documented claims were uncommon at best and this year, I've had exactly one of 'em.)*

In the controlled setting of a contest, Start, Turnpoint and Finish Cylinders may be 1 mile or whatever radius the contest organizers agree on, because all competitors are flying under the same set of givens. (Yes, Virginia, there is a Santa Claus, and if the contest task is a nice round 300 sm based on the centers of waypoint cylinders, you can be darned sure few if any of the top pilots actually flew 300 sm. It doesn't matter - all finishers are scored as a percentage of the fastest guy's speed over whatever the advertised distance was. T'was ever thus... with Sectors, they all tried to be right smack-dab OVER the waypoint because anything else was [literally] wasting time.)

Things are a little different for FAI badges and records. (As in "[insert whine here] MY 300 km flight was longer than YOURS because I used Sectors and you used Cylinders.") Because it's possible to fly a smaller inscribed task by using Cylinders rather than Sectors at all waypoints, any/all cylinders have a 1/2-km radius, and using this type of OZ carries with it "Cylinder Correction" penalties of 1/2 km every time the courseline crosses a Cylinder boundary.

It's been argued this penalty is mathematically indefensible, given the two 45-degree Cylinder quadrants within which the pilot may actually fly farther than a pilot using Sectors. Nobody wanted to contemplate the math involved in all that, however, so the penalty amounts to 1/2 km if a Start Cylinder is used, plus 1/2 km if a Finish Cylinder is used, plus 1 km for every Turnpoint achieved by Cylinder. (Ouch! Distance flown less 4 km for a 3-turnpoint task. Plan accordingly if you really want to try this any time soon! There's also a work-around to minimize Cylinder penalties: if you use Start and Finish LINES instead of the Cylinders there, the penalty for a 3-turnpoint task would "only" be 3 km; same story if distance is measured from release to landing via 3 Turnpoints, each achieved by Cylinder.)

A true sticky wicket: no one claim can use BOTH Sectors and Cylinders. (Well, that's not absolutely true, but it'll rip the heart out of your task to have one turnpoint disallowed because it was achieved by Cylinder ONLY and the other(s) were achieved by Sector ONLY.)

There is a move afoot to simplify the Sporting Code and within 2 years, the photo documentation that inspired Sectors in the first place will be gone the way of the dodo, replaced by flight recorders and - for Silver and Gold badges - hand-held GPS, if/as various units are approved by individual countries. As a result, some pilots favor OZ Cylinders as the only type of OZ to be permitted in the future, perhaps with a radius of 1 km (3280.8399 feet). Some favor allowing Cylinders and/or Sectors in a single claim, with Cylinder penalties applied only to the waypoint(s) where a Cylinder is used. Where will this discussion lead? Dunno... but I'm curious to see if anyone proposes the abolishment of Cylinder penalties, with a provision for Sector pilots to get extra credit...

For a flight made this season or next, ask yourself two questions:

When's the last time I sallied forth intending to be penalized?

How good am I at flying within 1640 feet of a given point?

For NOW, certainly, I'd be using physical landmarks as Start, Turn & Finish points, and I'd stick with sectors - they're bigger targets and you can visually confirm when you're on the proverbial Far Side. If you want to work on accuracy in anticipation of using Cylinders and/or waypoints that are merely coordinates without any correlating surface feature, practice entering and/or leaving the Sector by passing as close to the waypoint as you can, strictly using GPS navigation. It may take some practice to get this down pat!

Continuous Surveillance

"Continuous Surveillance" makes it sound like you were armed with binoculars and watched every second of the flight. (Hmmm... not bloody likely.) There being no Sporting Code definition, I apply a reasonable person standard: did you witness take off and/or landing (or are these confirmed by soaring site logs), and are you convinced - based on other pilots' in-flight sightings or the general lay of the land - that there was no possibility for the pilot to have landed and taken a second tow somewhere/anywhere between the take off and landing times you confirmed? If so, there was "continual surveillance."

Goal Flight Start/Finish

With thoughts of Diamond Goal dancing in your head, the best way to go about this is:

(1) DON'T be one of those pilots who's chagrinned to find declared coordinates taken from a published source actually plot to a location a mile or more from where they thought it was! Double-check to confirm ALL declared Way Point coordinates ARE where you THINK they are! (Google Earth is great for this - and it provides a look at ground references you can use in flight to make sure you can FIND the Start, Turn & Finish OZs. You can draw these on print graphics & take 'em with you... a great help for those flying without a moving map.

(2) release in lift, in the Start OZ or anywhere you like AT OR BELOW 3200' AGL** (relax a bit, scope out a couple of good thermals, perhaps fly a few miles out toward the first Turn Point... at least check to see where other gliders or dust devils are marking good lift on your intended first leg)

(3) when you've decided it's time to hit the road, return to the Start OZ and position yourself so you'll fly directly over declared Start Point coordinates on course toward the first Turn Point. (You can be as high as you like, but without a moving map, bear in mind: higher = harder to determine position relative to Start Point coordinates!)

(4) GO FLY, and at the end of the task, Sporting Code 4.3.3 at present permits you to land anywhere at your home airport OR within 1000 meters of the declared Finish Point, with or without entering the Finish OZ there.

** This - per Sporting Code 1.4.7 - allows release to be used for calculating Loss of Height, while the declared Start Point is used for distance measuring. This is by far the simplest way to avoid a Loss of Height penalty which can otherwise knock almost 2 miles off your credited distance for each 100 feet of "excess" loss of height, with 1000 meters (3281 feet) being the penalty-free maximum.

Under the current Sporting Code, a Start Line, Finish Line and/or OZ Sectors provide other options for the Start, Finish and measuring Loss of Height, but it's WAY more difficult to deal with all the intricacies of geometry trying to catch one end of a Start/Finish Line or one corner of Start or Finish OZ Sector within 1000 meters of its defining point... all while trying to keep track of Start Altitude, so you know how high your Finish Altitude must be to avoid a Loss of Height penalty... you have better things to do!

Fair warning: much of this may change as of October 1, 2009 - the earliest FAI/IGC could adopt a proposal they'll be reviewing in March 2009. The proposal seeks to require that ANY closed course (Diamond Goal or World Record speed!) must use Start & Finish OZ Sectors with a 1,000-meter radius, and Loss of Height would always be measured as the altitude interpolated at Start OZ Sector exit minus the highest altitude recorded within the Finish OZ. Under this proposal, a finish at landing would be OK ONLY if the Start OZ Sector exit is no more than 1000 meters AGL at the Start/Finish Point and the glider flies or rolls into the Finish OZ Sector there, within 1000 lateral meters of the Start/Finish Point. This would radically change the way most US Diamond Goal flights have been done for 50+ years...

Judy

*My Gold Distance leg flown 12 July 2006, OO'd by Jay McDaniel. - Jim.

Part of the OO's job is:

Altitude Correction

Where raw data indicates an altitude gain well OVER the minimum or a Loss of Height well UNDER the maximum, correcting for instrument error and non-standard pressure may not be a big deal. (Considering the two, however, non-standard pressure is in certain instances going to produce some whopping errors... think frontal passage...)

Altitude Analysis for FAI Badges

For accuracy's sake - and instances where the gain, Start or Finish altitude is or could be a close call, please see below. (I don't know whether you're dealing with a barograph or an FR, so can't give a concise one-sentence-covers all sort of an answer.) No matter whether a barograph or FR is used for badge flight documentation, the raw pressure data recorded must be corrected for *both* instrument error and non-standard pressure.

That second element is too often overlooked, but the reason it's needed is simple: the same barometric pressure changes requiring a pilot to re-set the altimeter before flight *also* influence the barograph or FR. So do the pressure changes a pilot may notice after landing, when the home airport may mysteriously register on the altimeter 100 or more feet higher or lower than it really is.

The barograph or FR calibration data and a bit of math are needed to determine in-flight altitudes accurately enough for badge purposes. (Worth noting: more math and considerably more detailed pressure data are required for Absolute Altitude and Gain of Height records.)

✓ **Mechanical barographs use Graphic calibration**
…but we're not going there.

✓ **Electronic Baros Use Numeric Calibration**
Electronic barographs and Flight Recorders must be calibrated either within the 24 months before a badge flight or within 2 months afterward. The calibration consists of columns of figures such as these:

True Altitude	Recorded Altitude
0	98
2000	2100
4000	4133
6000	6102
8000	8136
10000	10128
20000	20111
36000	36188

✓ **Correcting FR data for instrument error**

Interpolation is used to correct an FR recorded pressure altitude for instrument error between known values. In the example below, **492** is the pre-flight pressure altitude recorded at the soaring site and it's paired with "X" as the equivalent to be determined:

True Altitude	Recorded Altitude
0	98
"X"	**492**
2000	2010

Now, relative positions in the display form the basis for calculation. A spreadsheet comes in handy!

$$X = 2000 - \{(2010-492) * [(2000-0)/(2010-98)]\}$$

X = 412 feet

- Jot down interpolated values for pre- and post-flight data points, Release, Low, High, Start and Finish Altitudes.

- Keep track of which events took place nearer take off time and which were closer to landing time

✓ **Data recorded by Barograph OR Flight Recorder requires Correction for non-standard pressure**

No matter whether a barograph or FR was used, the final step in determining an in-flight altitude is correcting for non-standard pressure. Here's how:

a) *SUBTRACT* the calibrated altitude of the *pre-flight baseline (or data point)* you've already calculated from actual field elevation at the *take off site*. (A negative number may result)

b) *SUBTRACT* the calibrated altitude of the *post-flight baseline (or data point)* you've already calculated from actual field elevation at the *landing site*. (A negative number may result)

c) *For any event near take off time, ADD* the number found in step (a) to the calibrated altitude for the same event. The result is the event altitude, corrected for both instrument error and non-standard pressure.

d) *For any event recorded near landing time, ADD* the number found in step (b) to the calibrated altitude for the same event. The result is the event altitude, corrected for both instrument error and non-standard pressure.

Too much math? The 492-foot pressure altitude shown in the sample interpolation was recorded before flight at a soaring site where the elevation is 798' MSL. If not properly corrected for instrument error *and* non-standard pressure, an event occurring near this time and location would therefore appear to be 386 feet lower than it really was!