



2013 CIVL PLENARY – ANNEX 24B SOFTWARE PROPOSALS

In conjunction with the Hang Gliding, Paragliding and Aerobatic Subcommittees

1. Speed rank used to calculate time validity

At the 2008 CIVL plenary, the option was introduced to use not the fastest pilot to determine a task's time validity, but to use any other pilot instead. This has not been used since.

Proposal:

This option is removed from the scoring system.

2. Stopped tasks general procedures

Stopped tasks are often the source of much controversy. This may even lead to meet directors hesitating to stop a task, just to avoid this controversy. To counteract this development, a lot of work and thought went into this area within the PWCA, and by now their system works extremely well. Pilot acceptance is high, and it provides an added benefit of allowing even stopping and scoring races with multiple start gates and elapsed time races in a fair and sportive manner.

The idea is to require a minimum flying time of one hour for a task to be scored. In non-race tasks, this is determined by the last pilot to start the race. Pilots are then evaluated for the amount of time this last pilot spent in the race until it was stopped.

Similar to what is done in Hang Gliding, each pilot is scored for their best position 5 minutes before the task stop was announced. This is to prevent pilots from anticipating an imminent task stop and trying to gain a last-minute advantage by pushing low along the course line.

Pilots between ESS and goal at task stop time are allowed to fly into goal and validate their whole flight. This is to prevent a major drop in points between two pilots flying in close proximity towards goal, one having crossed the goal line, the other one being just meters behind it at the stop time.

To prevent another major drop in points, this time between two pilots flying in close proximity towards ESS, where one has just crossed ESS, and the other was about to at the task stop time, a reduction of speed points is introduced. A fixed amount of points is deducted from all pilots who are awarded speed points, and this amount is equal to the amount of speed points a pilot would achieve if he had crossed ESS exactly at the task stop time.

In a stopped task, pilots' best positions up to the stop time are considered their "landing position". Their best distance along the course line is then modified by applying the altitude bonus introduced a few years ago. This leads to a pilot distribution along the task distance that does not have much correlation with the task "difficulty" normally used to calculate 50% of the distance points (see also Proposal 4 below). This is why all distance points are awarded linearly in a stopped task – regardless of the decision taken regarding Proposal 4 below.

Proposal A:

S7A: Replace section 5.4.8 with:

5.4.8.1 General procedure for stopped tasks

- When a task is stopped the time of the first task stop announcement must also be announced.
- The Task Stop Time is 15 minutes before the task stop announcement for Race to Goal and Elapsed Time Tasks, or the same amount of time before the task stop announcement as lies between individual start gates in the case of a task with multiple start gates.
- A stopped task will be scored if the flying time was one hour or more. For Race to Goal tasks, this means that the Task Stop Time must be one hour or more after the Race Start Time. For all other tasks, in order for them to be scored, the Task Stop Time must be one hour or more after the last pilot started.
- Scoring of stopped Elapsed Time tasks or Race to Goal tasks with multiple start gates considers for each flight the time window which is equal to the flying time of the last pilot to start the race.
- Pilots are awarded an altitude bonus distance to their last GPS position at Task Stop time. This altitude bonus distance is equal to two times each pilot's altitude above goal height at Task Stop Time. Pilots are scored for this bonus-extended last position, or their best GPS track log position up to Task Stop Time, whichever yields the better result.
- In a stopped task, 100% of the distance points are awarded in a linear fashion.
- Pilots who were at a position between End of Speed Section and Goal at the Task Stop Time will be scored for their complete flight, including the portion flown after the Task Stop Time.
- A fixed amount of points is subtracted from the time points of each pilot that makes goal in a stopped task. This amount is the amount of time points a pilot would receive if that pilot had reached ESS exactly at the Task Stop Time.

Proposal B:

S7B: Replace section 5.3.6 with:

5.3.6.1 General procedure for stopped tasks

- When a task is stopped the time of the first task stop announcement must also be announced.
- The Task Stop Time is 5 minutes before the task stop announcement.
- A stopped task will be scored if the flying time was one hour or more. For Race to Goal tasks, this means that the Task Stop Time must be one hour or more after the Race Start Time. For all other tasks, in order for them to be scored, the Task Stop Time must be one hour or more after the last pilot started.
- Scoring of stopped Elapsed Time tasks or Race to Goal tasks with multiple start gates considers for each flight the time window which is equal to the flying time of the last pilot to start the race.
- Pilots are awarded an altitude bonus distance to their last GPS position at Task Stop time. This altitude bonus distance is equal to two times each pilot's altitude above goal height at Task Stop Time. Pilots are scored for this bonus-extended last position, or their best GPS track log position up to Task Stop Time, whichever yields the better result.
- In a stopped task, 100% of the distance points are awarded in a linear fashion.
- Pilots who were at a position between End of Speed Section and Goal at the Task Stop Time will be scored for their complete flight, including the portion flown after the Task Stop Time.
- A fixed amount of points is subtracted from the time points of each pilot that makes goal in a stopped task. This amount is the amount of time points a pilot would receive if that pilot had reached ESS exactly at the Task Stop Time.

3. Stopped tasks validity

After some stopped tasks where the majority of the field still flew in close proximity had become decisive for whole competitions, the PWCA developed a system to devalue stopped tasks. It adds a fourth validity, stop validity, to the existing ones (time, launch, and distance), and the day validity becomes the product of those four. This can be seen as a more dynamic alternative to the strict “70% validity of stopped tasks with no pilots in goal” rule introduced by CIVL in 2011.

For normal tasks, stop validity will always be 1. But for stopped tasks, it will be between 0 and 1, taking into account the number of pilots in goal, the task distance, the flown distances of all pilots, the number of launched pilots and the number of pilots still flying at the time when the task was stopped.

The idea is that a task should count fully if it has been decided and would not change much anymore if it had run longer than the stop time. Whereas a task that is still completely undecided at the stop time should not count anything.

Proposal A:

S7A: Add the following section:

5.4.8.2 Stopped Task Validity

Stopped tasks are scored with an additional Stopped Task Validity criterion, which will be a value between 0 to 1, taking in account the number of pilots in goal, the task distance, the flown distances of all pilots, the number of launched pilots and the number of pilots still flying at the time when the task was stopped. The Day Quality is then calculated by multiplying all four validity values (launch, distance, time, and stopped task). The Stopped Task Validity calculation is given below:

NumberOfPilotsReachedESS > 0 : *StoppedTaskValidity* = 1

NumberOfPilotsReachedESS = 0 :

$$\text{StoppedTaskValidity} = \min\left(1, \sqrt{\frac{\text{BestDistFlown} - \text{avg}(\forall i : \text{DistFlown}_i)}{\text{DistLaunchToESS} - \text{BestDistFlown} + 1}} * \sqrt{\frac{\text{stdev}(\forall i : \text{DistFlown}_i)}{5}} + \left(\frac{\text{NumPilotsLandedBeforeStopTime}}{\text{NumPilotsLaunched}}\right)^3\right)$$

Proposal B:

S7B: Add the following section:

5.3.6.2 Stopped Task Validity

Stopped tasks are scored with an additional Stopped Task Validity criterion, which will be a value between 0 to 1, taking in account the number of pilots in goal, the task distance, the flown distances of all pilots, the number of launched pilots and the number of pilots still flying at the time when the task was stopped. The Day Quality is then calculated by multiplying all four validity values (launch, distance, time, and stopped task). The Stopped Task Validity calculation is given below:

NumberOfPilotsReachedESS > 0 : *StoppedTaskValidity* = 1

NumberOfPilotsReachedESS = 0 :

$$\text{StoppedTaskValidity} = \min\left(1, \sqrt{\frac{\text{BestDistFlown} - \text{avg}(\forall i : \text{DistFlown}_i)}{\text{DistLaunchToESS} - \text{BestDistFlown} + 1}} * \sqrt{\frac{\text{stdev}(\forall i : \text{DistFlown}_i)}{5}} + \left(\frac{\text{NumPilotsLandedBeforeStopTime}}{\text{NumPilotsLaunched}}\right)^3\right)$$

4. Distance points

Currently, distance points consist of two parts: A linear part (x points per km flown) and a non-linear part where points are awarded based on a calculated difficulty of the task portions a pilot managed to fly over. Both portions give up to 50% of the available distance points. Nowadays, with increasing cylinder sizes and the idea of offering several route options for a task, this no longer has much relevance. The PWCA will remove the non-linear difficulty portion in 2013, and use the existing linear calculation for 100% of the awarded distance points. CIVL should do the same.

Proposal:

For each pilot p:

$$DistancePoints_p = \frac{Distance_p}{BestDistance} * AvailableDistancePoints$$

(Note: this is the formula currently used for 50% of the distance points)

5. Nominal launch

In big competitions, each day, 1 or 2 pilots will not launch, for various reasons. The current launch validity formula devalues such days. It is generally understood that such days should still have full validity, and be able to award 1000 points to the task winner. This can be achieved by introducing a fifth GAP formula parameter: “Nominal Launch”. For example, in the PWC, Nominal Launch is 95%, so unless fewer than 95% of the pilots launch, the day will be able to be fully valid (depending on the other validities).

Proposal:

The Launch validity of a task is set at 1. It starts devaluating if more than 5% of the pilots did not launch.

6. No pilot in goal

In 2011, a rule was introduced for Paragliding competitions to devalue all tasks with no pilot in goal by 20%. We believe this rule to be unnecessary for the following reasons:

1. If no pilot is in goal, the maximum number of points awarded by the GAP formula is 912, not 1000, on a fully-counting task.
2. Properly set GAP parameters for a competition venue will ensure that such a task is no more decisive for the overall competition outcome than tasks where pilots do reach goal.

Proposal:

Remove chapter 5.3.5 from S7B

7. Arrival points

Over the last few years it was found that fast pilots are rewarded sufficiently with Leading and Time points. Additionally, especially with Ranking-Based Arrival Points as currently used within GAP, safety became an issue because people tended to race each other at their gliders' top speed (or even beyond) on final glides. Since 2011, the PWCA awards no Arrival Points any more: those available points go into Time Points instead. Only exception: If ESS and goal are identical, Arrival Altitude points are awarded, to encourage safe flying. These are awarded in such a way that the most efficient height to arrive above the goal field is 300-400m. If a pilot were able to reach goal on a maximum speed glide, he would then fare better by gliding at a lower, safer speed.

Proposal A:

Alter the scoring formula to remove arrival points. The available points are instead used to increase the amount of time points awarded.

Proposal B:

Introduce the concept of Altitude Arrival Points in the scoring formula: They are only awarded when ESS and goal are in the same place, and are calculated using each pilot's GPS altitude above goal. The formula is given below:

$$Curve = 6$$

$$Altitude_{max} = 1500$$

$$f(a,k) = 1 - 1/e^{a/k}$$

$$k1 = Curve * \sqrt{Altitude_{max}}$$

$$k2 = \frac{AvailableArrivalPoints}{f(Altitude_{max}, k1)}$$

$$ArrivalPoints_p = k2 * f(Altitude_p, k1)$$

8. Leading points

A problem that was found with the existing Leading Points calculation is that they disproportionately reward leading towards the end of task. Pilots and organizers often criticize that leading out early on is not rewarded sufficiently, which counteracts leading points' purpose. The adjustment is relatively simple, in the distance/time graph used to determine the leading coefficient for each pilot, use (distance to ESS)² instead of (distance to ESS). This has been applied by the PWCA for the last 3 years very successfully: Leading out early in the race is now rewarded, and pilot acceptance of leading points has very much improved.

Proposal:

Alter the leading points calculation formula to use (distance to ESS)² instead of (distance to ESS)

9. Parameters to be set by an organizer

FS offers the option to set a number of parameters for each competition. Besides the classic "GAP parameters", there are a number of "technical" parameters: Use of distance, departure, arrival, leading points, treatment of pilots starting too early, or reaching end of speed section but not goal, etc.

The technical parameters exist to enable FAI-2 organizers to work with old versions of GAP (for whatever reason) and to implement the differences between hang gliding and paragliding rules. The Sporting Code should define exactly what parameters are at the organizer's discretion in Category 1 events.

Proposal:

S7A 5.2.3. and S7B 5.2.3. are modified to read as follows:

The program and scoring formula to be used will be stated in the Local Regulations. The GAP scoring parameters will be decided at the first team leaders meeting and published in writing by the organizer prior to the start of the first task. These parameters are: nominal launch, minimum distance, nominal distance, nominal time, and nominal goal. These parameters must not be changed after the event's start.

10. GPS distance measurements

Calculating the distance between two points from their respective coordinates depends on what shape earth is considered to be in: A sphere, or an ellipsoid. Depending on which model one uses, calculated distances may differ quite a bit.

The FAI Sporting Code General Section states regarding distance measurements:
SC GS 7.3.1.1: Distances on the earth's surface: For FAI distance calculations, the earth model used may either be the WGS84 ellipsoid or a sphere of radius 6371 km exactly. For accurate measurement and calculation of distance, Air Sport Commissions shall choose which model is to be used in their area of activity.

Within S7, only S7D - Records and Badges refers to this:

S7D 5.2.1 Measurement of distance: For all records and for badge flights, distances shall be measured by GPS or approved flight data recorder. In this case, the GPS datum used shall be WGS84 and the earth model shall be the WGS84 Ellipsoid. See General Section 7.3.1.1.

No indication is given in S7A or S7B as to which model should be used.

Common practice within CIVL so far has been to allow both models, for practicality's sake, given that both are used by different instruments in use by pilots. The potential difference between the two models was noticed early on when GPS was introduced, and dealt with by the 0.5% tolerance found in Section 7A and 7B, 15.3.2.

FS, our official scoring software, implements the FAI sphere and applies the 0.5% tolerance to all measurements, PG and HG.

Of the instrument and/or software manufacturers known, all except one implement the FAI sphere: Flytec/Bräuniger, Aircotec, DigiFly, Compass (C-Pilot), LK8000, XCSoar... The exception is Flymaster: they implement the WGS84 ellipsoid, but changed their implementation as a result of our discussion; their newest firmware can now use either the ellipsoid or the FAI sphere.

All general purpose GPS receivers, most prominently Garmin products, use the WGS84 ellipsoid.

This was no problem as long as cylinders used in competitions were small. But with the big cylinders used nowadays, differences between those two models add up to several hundreds of meters, providing a potentially unfair advantage to pilots with the "right" instruments and a deeper understanding of how FS distance calculations work.

We have three options:

1. Leave everything as is. Least amount of work, but creates a potentially unfair situation. This is also not quite in line with the Sporting Code's General Section. If this is chosen, I recommend making the issues mentioned above public, so that all pilots have a fair chance to change instruments and adapt their flying style.
2. Define that all distance calculations must be based on the FAI sphere:
 - Define a year, from then on this rule is valid for FAI Category 1 competitions (and will probably trickle down to Category 2 comps). We suggest 2014. This will give top pilots time to look for an alternative to their backup Garmins.
 - Define a much smaller tolerance of 0.01% of cylinder radius, with a minimum of 1m, for the 2014 season and onwards in both S7A and S7B. This will be implemented in FS.
 - The rules must then state that the use of instruments which base their distance calculations on the ellipsoid is not recommended, and that it's each pilot's

responsibility to provide a track that is valid according to FAI-sphere-based distance calculations.

Problem: The very popular Garmin instruments will become obsolete, pilots using them as main and/or backup instruments will be forced to get a new instrument or use different cylinder sizes in competitions.

3. Define that all distance calculations must be based on the WGS84 ellipsoid:

- Define a year, from then on this rule is valid for FAI Category 1 competitions (and will probably trickle down to Category 2 comps). We suggest 2014. This will give free flight instrument manufacturers time to implement the more complicated measurement. It will also give us time to implement the same in FS.
- Define a much smaller tolerance of 0.01% of cylinder radius, with a minimum of 1m, for the 2014 season and onwards in both S7a and S7b. This will be implemented in FS.
- Also define which calculation method will be used in FS, and make that information available to manufacturers, to keep errors from different implementations as small as possible.
- Manufacturers must provide a firmware release number from which onwards the distance calculation is based on the ellipsoid.
- The rules must then state that the use of instruments or firmware releases which base their distance calculations on the FAI sphere is not recommended, and that it's each pilot's responsibility to provide a track that is valid according to WGS84-ellipsoid-based distance calculations. If possible, this also lists the recommended instruments and release numbers in an appendix.
- Implement a check for the firmware/instruments in FS.

Problem: Will require instrument manufacturers to update their firmware, which may not always be possible. Flytec for example indicated that correct ellipsoid calculations would not be possible on their current competition device, and that they would have to do something simpler that will approximate those calculations.

Older instruments, like for example the Flytec 5000 series, Aircotec, etc., which are still in use even in FAI Category 1 competitions, will become obsolete, since their software is no longer maintained in many cases, and/or they lack the necessary calculation power.

There is no good way, we are aware of that. But we think one of those will have to be chosen.

A fourth solution has been discussed, but found to not be an option:

Calculate distances in FS according to the model used in the GPS device - ellipsoid for Garmin, sphere for others. This would still mean that pilots can use the "right" instrument to optimize the distance they have to fly, and somebody flying with a mix of the two models will still have to fly further to ensure both instruments record a point inside a cylinder, than somebody who only uses the "right" instrument. This creates a lot of work for the scoring software, but provides no improvement over the current situation.

Proposal:

Decided for either option 2 or 3 above, to be implemented starting May 1st, 2014 (or a later date if the Plenary feels pilots and/or instrument manufacturers should be given more time for the change).

11. GPS altitude measurements

Similar to distance, there are also two models on which GPS altitude is calculated: The WGS84 ellipsoid (again!) and a thing called the "Geoid", which is an even more accurate representation of the earth's shape.

Regarding altitude measurement, the FAI Sporting Code General Section states:

SC GS 7.3.1.5 Altitude. Methods for the measurement and checking of altitude are determined by the FAI Air Sport Commission concerned. These may be by the use of calibrated barographs, flight recorders (including those recording GNSS fixes as well as pressure altitude), sighting frames, observation aircraft, or ranging radar.

GNSS = Global Navigation Satellite System - for example GPS.

Note that the General Section does not mention the model to be used.

Right now, in CIVL we use whatever the instruments give us. As Mark Graham determined a few years ago, instruments are split nearly 50/50 between ellipsoid- and geoid-based altitude calculations (see <http://www.xcmag.com/wp-content/uploads/2011/07/GPS-Altitude-Table.jpg>). Depending on where you are on the globe, differences between those two can be up to 100m. In most parts of Europe, for instance, it's about 60 or more meters (http://www.esri.com/news/arcuser/0703/graphics/geoid3_lg.jpg). So two pilots flying at exactly the same altitude may be evaluated as 100m apart in altitude based on what instrument they use (not even thinking about GPS accuracy!).

This can be troublesome if we use GPS altitude to determine whether a pilot was or was not in violation of airspace rules. This will be even more troublesome once we start handing out points and determining winners based on GPS altitude.

According to Flytec, all GPS modules in use worldwide always return the altitude based on the geoid, along with the correction necessary to achieve the ellipsoid value. So changing the implementation to a unified standard across all instruments should be relatively straight forward. Still, for some older instruments, manufacturers may choose not to do it, and we will have to exclude those instruments going forward.

Proposal:

- Define that starting May 1st, 2014 (or a later date if the Plenary feels pilots and instrument manufacturers should be given more time for the change), all GPS altitude calculations must be based on the Geoid.
- Manufacturers must provide a firmware release number from which onwards the altitude calculation is based on the Geoid.
- The rules must then state that only the use of instruments or firmware releases which base their altitude calculations on the Geoid (=“MSL”) are permitted in FAI Category 1 competitions. If possible, this also lists the permitted instruments and release numbers in an appendix.
- Implement a check for the firmware/instruments in FS.