GPS Triangle Regulations for “Light-Class” Gliders DRAFT

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The following ruleset for "Light-Class"-GPS-Triangle soaring is a provisional ruleset and under development.

The development of these rules is still ongoing at the moment being.

The rules will stay provisional and subject to changes during the experimental phase of these competitions which started in 2020.

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1 Definition of GPS Triangle soaring for Light Gliders

1.1 Purpose and Goals

GPS Triangle competitions are meant to build a bridge between model soaring and full-size soaring competitions. Its goal is to display cross country soaring competitions of full size soaring in the scale of our model aircraft. The task, while competing on a GPS Triangle contest is to fly around a virtual triangle (perimeter ~0,966 km for the "light-class") as often as possible in a period of 20 minutes. In order to obtain comparable results, the maximum starting altitude (usually 200 m) and the maximum starting speed (usually 60 km/h) when crossing the starting line are equal for all pilots.

The fascinating aspects of a GPS Triangle contest are:

• Lots of activities in the air (e.g., various gliders flying at the same time, takeoff by hand)

• A lot of flight time for each pilot during the competition

• Offering a wide variety of tactical decisions in combination with optimized teamwork between pilot and helpers.

• Flying with high performance gliders.

• Combining a complex flight task with rules as simple as possible

• Easy organization with only very few helpers

1.2 General Rules

For the execution of a GPS Triangle contest, the technology of satellite navigation with data communication from the model to the pilot is used. Together with the use of Data Loggers, the position (latitude, longitude and altitude) of the glider can be determined and verified in real-time. This simplifies both the flying operations and the evaluation of the flight.

Every pilot must use commercially available navigation equipment, compatible to the specifications described in **Appendix 2** (See Scale-Class rules). Pilots are not allowed to use more than two systems, whereas, one is the main system and the other is the backup system. The applied system must be certified by the GPS Triangle Committee.
Every pilots' aircraft must be controlled solely by himself. In the case that the aircraft is controlled by someone other than the pilot, the competitor will receive a zero score (0) for the aggregate heat.
The scoring of the individual flights to compute the individual results is based on the logged flight data and is calculated in the contest directors' office. The details of the data to be logged for scoring is shown and explained in **Appendix 2**(See Scale-Class rules)**.**
The following flight data from existing and permitted navigation systems can be submitted to the competition officials in order to calculate the results.

The applied system must provide information after the flight about:

- Starting time (in UTC)
- Task starting altitude (in m)
- Task starting speed (in km/h)
- Flight time (i.e., a period starting when glider crosses starting line until it completes last triangle in min:sec)
- Number of triangles (n)
- Average speed, at which the triangles (multiple of 0.966km) were done
- Violation of safety area(s)
- Logging of Motorswitch. “Motor off” shall be logged with according time-stamp (shall be implemented as soon as possible)

Note: To validate the logger the motor must be switched on for a short time prior to the launch.

In addition, the system must provide a check code. This is generated based on the data above (e.g., starting time, task starting altitude) and is to ensure that no errors occur when processing the information from the flight card to the stationary evaluation software.

Note: (The navigation system and/or the Navigation-Application need to be able to store each flights’ flight data in igc-format – Logfile format is described in Appendix 2 Scale-Class rules. This rule shall be implemented as soon as possible and will be pronounced on time)

The use of additional variometers is limited to devices operating on frequencies in the 2.4 GHz band.

1.3 Use of Telecommunication Devices

The use of any electronic device other than for piloting or navigating the model aircraft is forbidden. Mobile phones have to be switched off or turned into flight mode on the flying site.

1.4 Insurance

Each participant must provide sufficient liability insurance for personal injury and property damage that covers damage resulting from the use of his model airplane. (Usually 2.0 Mio €)
With his registration the participant agrees to not assert claims or legal action against the organizer or other competitors. The participant bears all risk of the causes followed by the usage of his model aircraft by himself.

1.5 Rules of conduct to avoid midair collisions

To avoid collisions in the air every pilot needs to obey following rules of conduct to avoid midair collisions, or even collisions on the ground.

- If two models head towards each other in straight line flight, every model has to be steered to the right (aileron right) to avoid a collision.
- In every group the circling direction for thermaling is fixed. Group A is circling left, group B right, group C left and so on.
- Circling models have the right of way. Models flying in a straight line must fly around circling models to avoid collisions.
- Avoiding optical crossings of the models' flight paths is mandatory
- Models which came to rest after landing have to be removed from the touchdown area by each pilots' helper as quickly as possible.

Please note: There will be NO Reflights given under any circumstances after midair collisions between 2 or more aircrafts.

1.6 Safety on the flying site

The organizer must clearly mark the boundary between the landing area and the safety area assigned for other activities. (See sketch "flying field layout")
The competition director has the right to interrupt the competition out of safety reasons (unsafe conditions) at any time.

1.7 Launching direction

All launching shall take place in an area designated by the organizer with provisions made for launching into the wind (headwind component).

1.8 Weather Conditions / Interruptions

a) Interruption and Resumption of the competition due to bad visual conditions:

The Contest Director has to ensure that models flying the triangular course below the dedicated entry altitude will always be visible. If this is not the case (i.e. due to low cloud base or fog) the Contest Director has to neutralize the group in flight and interrupt the competition. It is recommended to launch the group again as soon as the visible conditions permit.

b) Interruption and Resumption of the competition due to high wind speeds:

The maximum wind speed for contests is ten (10) m/sec. The contest has to be interrupted or the start has to be delayed by the contest director if the wind speed exceeds ten (10) m/sec measured three (3) times for at least twenty (20) seconds in a time interval of five (5) minutes two (2) meters above the ground at the start area.

c) Interruption and Resumption of the competition due to rain:

In the case of rain he ongoing round has to be interrupted as well. The Contest Director has to neutralize a group in flight and interrupt the competition until the rain will stop. All pilots have to land their planes as soon as possible as soon as the Contest Director neutralized a group in flight. The group which was neutralized will reassume the competition at a later time as soon as the rainfall has stopped.

2 Light Glider and Technical Equipment

2.1 Definition of a Light Glider

A Light Class glider is defined as a radio-controlled glider which is equipped with an electric engine for the start and it must comply with the specifications mentioned in paragraph 2.2.

2.2 Specification of a light-Class-Glider

Criterea:

Value	Size	Tolerance
Wingspan	2700 - 4000 mm	10 mm
Surfaceloading (“FAI” - including the projected area of wing and horizontal tailplane)	12 - 30g/dm²	For measurement the tolerance of the used scale is valid
Weight	max. 3000g	For measurement the tolerance of the used scale is valid

The pilot must always be able to prove that his model complies with the rules. The information on the official homepage of the manufacturer or in case of self-construction the construction plans apply.

2.3 Number of Light-Class-Gliders per pilot

During a GPS Triangle competition each pilot may use a maximum of two Light-Class gliders or two different configurations. These Light-Class gliders are called A-Model and B-Model. Each detachable part of the aircraft which defines its outline must be marked with a distinctive identification label (for instance Model A, Model B). The labels have to be documented on the starting card and for each flight the pilot must checkmark the glider used. (This rule stays active as long as scoring will be done using scorecards)

2.4 Ballast & Replacement parts

All parts can be interchanged between A-Model and B-Model. Further or additional parts (other than from A- or B-Model) are not allowed and wıll lead to a zero score for the aggregate flight if they will be used.
Changing or replacing components of the radio equipment, navigation system, power unit or electronic items is allowed. Using ballast is permitted. Water ballast is also permitted and can be jettisoned during flight. When ballasting, the maximum wing loading limit (see paragraph 2.2) must not be exceeded.

2.5 Loss of Parts

If the model aircraft loses a part (other than water ballast) during takeoff or flight the aggregate flight will be scored with zero points. The loss of a part after a midair collision or during the landing will not be considered in scoring.

2.6 Navigation & Data-logger

For navigation during flight a compatible system (data logger) has to be used. This system transfers GPS-data from the model aircraft to a receiving device (Ground station) and fulfills the following additional requirements:

- The performance of a flight (number of triangles, starting altitude, average speed over all triangles) can be determined immediately after landing using the receiver equipment
- Only systems fulfilling the specification (cf. Section 7 “Appendix 2” (See Scale-Class rules)) are allowed for the flight navigation and flight evaluation.

The technical details for basic requirements concerning the navigation systems as well as a list of accredited systems is shown in Appendix 2 (See Scale-Class rules).

2.7 Gyros, Auto Pilots & Telemetry

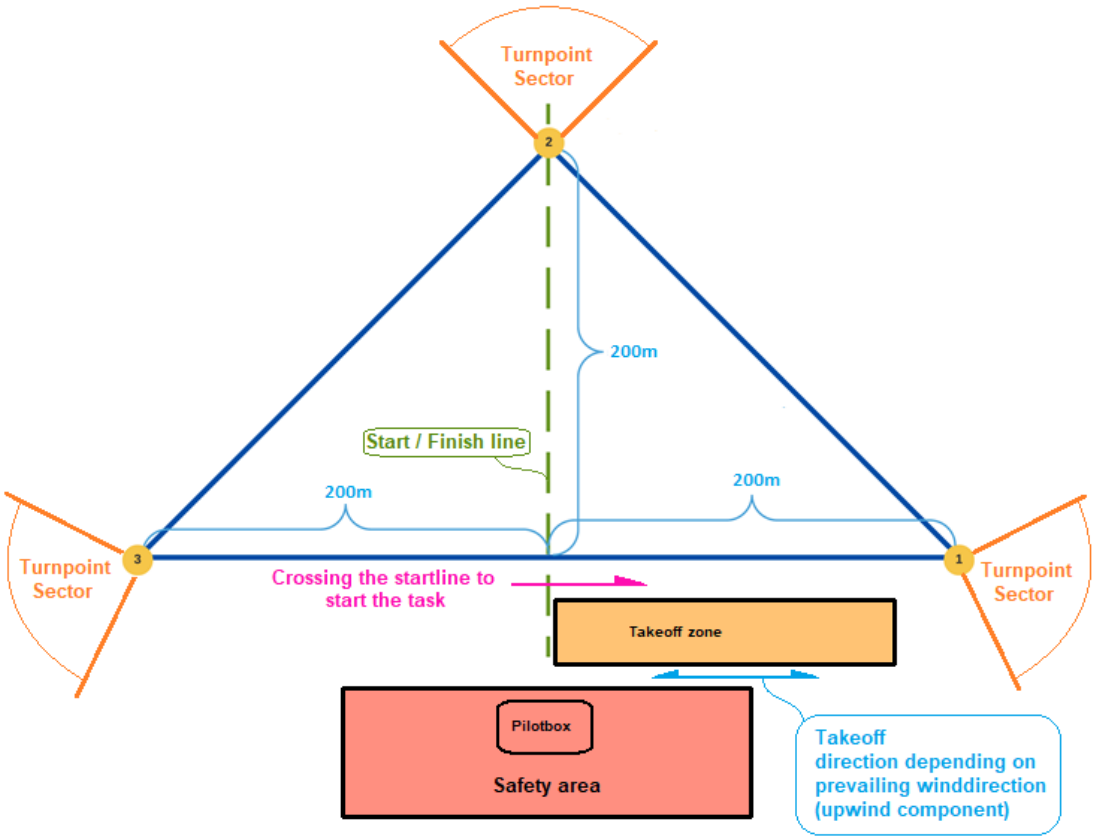
Gyros, flight augumentation systems or Autopilot systems, or the usage of data generated by such systems are not permitted.

It is not permitted to connect the telemetry-receiving unit with the radio control transmitter (e.g. Speed Indicator Signal with Flap Function) in order to send a corrective signal to the model.

Doing so will result in disqualification from the GPS Triangle contest.

3 Flying Field

The flying field and the virtual triangle design:



The position and the size of the Take-off Zone as well as the Security Zone may vary because of geographical circumstances of the flying field. The Take-off Zone conforms to the minimum width of 20 meters and a length of at least 50 meters. The Pilots Area's position inside of the Security Zone can be chosen freely by the contest director. The sketch above is not true to scale. The view of the area in which the triangle is placed should be unrestricted

Depending on the terrain the organizers of the competition may declare Security Zones and/or "No Fly-Zones" and/or "No Landing-Zones", which are defined by an outline and/or a height band. If one of these Security Zones is violated, this flight is getting judged with zero points. Additionally the maximum allowed altitude is 350m AGL. This altitude limit is valid at all time and never to be surpassed. If the maximum altitude will be violated the aggregate score for this flight will be zero (0).

4 Organization of a GPS Triangle Contest

4.1 General Rules

4.1.1 Contest Organization

The contest organization provides the following personnel:

- Contest director: responsible for the entire GPS Triangle contest and shall not participate as active pilot in the contest.
- Supervisor of Flying (SOF): responsible for coordination of departures, landings, times and weight of the models. Every pilot having finished the official task will announce his landing. The SOF will confirm the correct landing procedure (see 5.6.2) on the control card except for the Speed-Heat (there are no landing points).
- Evaluation officer: responsible for entering the flight results and creating intermediate and final ranking lists
- Jury: three persons well knowing the GPS Triangle contest rules and being able to decide in cases of doubt or problems. Jury members which are also pilots must be replaced by other persons for questions / problems concerning themselves.
- Tasks of the jury: Possible irregularities, or decisions made by the contest director or the supervisor of flying respectively can be claimed by every competitor. In case of an appeal the jury has to come together to decide whether or not the appeal will be overturned.
- The reason for a complaint in verbal- or in written form is to get a correction without the need of a formal protest. It is recommended to submit a complaint before submitting a protest.
- Protests have to be submitted to the contest director in written form and in English language. Furthermore the protest is linked to a fee amounting to 100 Euro. The jury which has been nominated prior to the start of the competition has to come together and has to agree on a decision in this case. A simple majority within the jury members is sufficient to refuse or grant a protest. The protest fee is only going to be refunded if the protest is granted. No appeal or protest can be lodged against the decision of the jury.

Deadlines for submitting protests

- Prior to the start of the event: A protest against the validity of participation, the qualification of the participants (pilots), the competition rules, the flying field and the competition area, the processing of glider models, the jury or other officials has to be submitted at least one hour before the event starts.

- During the event: A protest against a decision of the contest director, other officials, or against a mistake or irregularity committed by another participant during the event must be submitted as soon as the competition allows. The complaint must not be filed any later than 90 minutes after the start time frame of the respective group in which the incident occurred. Note: A protest against official results must be submitted immediately after the official results have been published on the airfield, but no later than at the award ceremony.

4.1.2 Pilot & Navigator

The participants are randomly assigned to a group by the GPS Triangle Evaluation Software. During a flight, a pilot may be assisted by a single navigator. It is of importance that only pilot and navigator are inside the Pilots Area. The noise level has to be reduced to a minimum. As a consequence voice prompts (except beeps and similar sound signals) should be transmitted via headphones.

4.1.3 Radio Frequency Control

Only frequencies authorized by the national authorities may be used; it is the responsibility of the participant to ensure this. The contest director or the Supervisor of Flying are authorized to perform a frequency control at any time.

4.1.4 Navigation System Frequency Control

The contest director assigns each pilot/navigator team a maximum of two frequencies for the transmission module of the GPS system in the glider model. The correct setting of the frequency is up to each pilot. It is recommended to make use of the four-eye principle (pilot/navigator are monitoring each other). At any time there are exactly two frequencies which may be used by the pilot/navigator team. The commissioning of a navigation system with a frequency other than the assigned frequency will result in disqualification form the competition. This rule does not apply to navigation systems with frequency hopping.

4.2 Definitions

4.2.1 Definition of the Contest

A GPS Triangle contest consists of at least three GPS Triangle heats.

4.2.2 Definition of a Heat

For each heat, the GPS Triangle Evaluation Software equally distributes (random) the participating pilots into groups. The number of pilots determines both the individual group size and the number of groups.

Note that a Heat always consists of at least 2 groups, whereby each contains a minimum of 3 and a maximum of 13 pilots.

A heat consist of one or more attempts for the pilot as per 4.2.3 and 4.2.4 and subsequently the official flight (see section 4.2.5)

When distributing the pilots into groups, it must be guaranteed that two pilots of one team are not assigned to the same group and subsequently do not have to fly at the same time. Therefore, the pilots need to inform the officials about their team membership when signing up for the contest. In a single heat, each competitor of pilot/navigator team will be used as a pilot once and once as a navigator.

4.2.3 Definition of an Attempt

An attempt begins with the take-off of the glider. The attempt is completed when the glider is launched to the predefined starting altitude of the heat.

4.2.4 Repetition of an Attempt

An attempt may be repeated if the glider has not reached the predefined starting altitude of the heat. The number of repetitions is not limited as long as the official Flight Window of the group is open. However, after the first attempt, it is not allowed to replace any parts of the glider. This applies to all mechanical parts.

The electric engine can only be used within the default start time window and before overflying the start line to start the new working time (evaluated flight). The engine can be switched on again to regain altitude for a new evaluated flight, as long as the start time window is still open. However, the previous evaluated flight is cancelled.

If the engine is turned on during the evaluated flight, it will be judged with zero points

4.2.5 Definition of an official Contest Flight (evaluated flight)

After a completed attempt the pilot must start the official evaluated flight by crossing the starting line at or below the predefined starting altitude with a maximum of 60 km/h. If the pilot flies too high or too fast when crossing the starting line he may accept a penalty or needs to re-cross the starting line. Each pilot can do only one official evaluated flight per heat.

5 Flight and Scoring

5.1 Preparation

The groups are randomly determined via the GPS Triangle Evaluation Software. It has to be made sure that the two pilots of a helper team are never assigned to the same group. Should a heat consist of more than three groups, the pilots of the same team may not be assigned to consecutive groups within the heat. The Contest Director sets a start time window for each group and announces this time window before the start of the heat. The start time window determines within which time from the start time all pilots of the group have to have flown over the starting line. The duration of the start time window depends on the number of pilots in one group (see table below). It is set between 4 and 59 seconds and 8 minutes and 59 seconds. The start time window is given in whole minutes, counting the last minute to the start time window.

Table: Starttime-Window in minutes depending on the group-size:

Pilots per group	Starttime-Window in minutes
3	4
4	4
5	5
6	5
7	6
8	6
9	7
10	7
11	8
12	8
13	8

The start time window is communicated by the contest director as soon as possible. Nonetheless, the start time window opens not earlier than 10 minutes after the last glider of the preceding group has landed. The pilots have to be ready to take off and be within the starting queue not later than 5 minutes before the start time window opens. The Contest Director may approve the takeoff of the glider models 5 minutes before the start time window opens.

5.2 Flight Task and Flight Time

For scoring the following rules must be followed:

- The finish line must be crossed with a speed of at least 10 km/h; otherwise the crossing and also the last round will not be counted.
- The pilot has to fill out the evaluation card right after the flight and present it to the scoring office if online scoring is not applicable.

5.2.1 The Flight Task

The flight task consists in flying around the defined triangle as many times as possible within the specified flight time (usually 20 minutes). The flight time starts with the last crossing of the starting line within the predefined start time window.

5.3 Scoring rawpoints

The score is computed by the triangle points, and the penalty points.

$$Rawpoints = Triangle\ Points - Penalty\ Points$$

5.3.1 Triangle Points

Every pilot gets 200 rawpoints per completed triangle. If there is more than one pilot in a group having the same number of completed triangles, the points for the last triangle are calculated as follows:

- Only the pilot with the highest average speed over all his triangles gets 200 rawpoints for the last triangle
- Pilots with the same amount of completed triangles are only getting partial points. These points are in propotion to the highest possible score of 200 rawpoints of the pilot with the highest average speed. The points for the slower pilots are calculated as follows:

$$Rawpoints\ for\ the\ last\ absolved\ triangle_{pilot} = 200 * \left(\frac{v\emptyset_{Pilot}}{v\emptyset_{fastest\ Pilot}}\right)$$

$$v\emptyset_{Pilot} = average\ speed\ of\ the\ according\ pilot$$
$$v\emptyset_{fastest\ Pilot} = average\ speed\ of\ the\ fastest\ pilot$$

Hereby the average speed is calculated as follows:

$$average\ speed\ v\emptyset = \frac{(number\ (n)\ of\ triangles\ *\ course\ distance\ of\ 1\ triangle\ in\ km)}{flight\ time\ in\ h}$$

5.3.2 Penalty Points

Crossing the starting line above the predefined starting altitude and/or at a speed above the maximum starting speed of 60 km/h, the pilot gets penalty points as follows:

$$PenaltyPoints = 50 + 2 * (Starting\ Alt. - Max. Starting\ Alt.) + 2 * (Entry\ Starting - Max.\ Starting\ Speed)$$

The pilot may accept a penalty and start the official contest flight or may do a new attempt in re-crossing the starting line as long the start time window is open. The penalty points are deducted from the total rawpoints score of the pilot.

Note: Violating a security zone (area, height) or landing in a "No-Fly-Zone" or "No-Landing-Zone" as well as violating the maximum allowed altitude of 350m AGL will result in 0 points for this flight.

5.4 Results

5.4.1 Evaluation of the Results

For every group there is a separate classification of 1000 points. The pilot with the highest score in rawpoints – possible Penalty Points taken into consideration – is awarded with 1000 points. The other pilots in this group are getting proportionate scores in relation to the highest score within the group.

$$Points_{Pilot} = \frac{Raw - points_{Pilot}}{Raw - points_{Best}} * 1000$$

$Rawpoints_{Pilot}$ = Points of the pilot

$Rawpoints_{Best}$ = Best score of a pilot in this group

It is not possible for pilots to get a result lower than 0 points. The calculation methods, definitions and algorithms for the evaluation of the results are shown in Appendix 2 (See Scale-Class rules).

5.4.2 Intermediate Score and Final Ranking

The evaluation officer creates an intermediate score list after each heat. The results have to be made public by the Contest Director not more than 30 minutes after the heat was completed (Chance to appeal and protest).

The cumulated points are the final results. If there are six (6) heats or more flown, the worst heat of a pilot is not added to the final result and will be called “discard-round”. Before publishing the final ranking, the contest director must control the final calculation of the results according to a standardized check list.

If multiple pilots reached the same final score, the ranking of these pilots depends on the following criteria sorted in order of priority:

1. The highest score discard round.
2. The overall number of completed triangles
3. The highest average speed in one of the Heats.

6 Appendix #1:
Maximum Take-Off Weight for light class models at maximum allowed surfaceloading (30g/dm²):

(To be filled with data of available models)
(If you want to add an aircraft or change data of a listed aircraft please write to: info@gps-triangle.net.)

Model name and version (Span in mm)	Surface area (in dm²)	Maximum weight (in g)
AVA (pro) (3150)	74.66	2239
Aspire (3700)	87.9	2637
Avenger F5J (3680)	83.33	2516
Carbonita (4000)	95	2850
Crozilla F5J (3440)	76,1	2283
Cyclone pro V (3810)	87.2	2616
Delphin (3905)	87.3	2619
El Nino (3930)	78.4	2352
Electra 2 (3500)	76.2	2286
Electra 2 (3900)	84.2	2526
Euphoria F5J (3600)	83.83	2514
Experience pro (3333)	71.8	2154
Explorer 1 / 2 / BF (3500)	84.65	2539

Explorer 1 / 2 / BF (3700)	89.8	2694
Explorer 1 / 2 / BF (3800)	90.3	2709
Explorer 1 / 2 / BF (4000)	95.5	2865
Explorer 3 (3450)	84.5	2535
Explorer 3 (3750)	90.1	2703
F5J Cobra (3980)	92.92	2787
F5J Edge (3800)	82.3	2469
F5J Vertigo (3970)	87.1	2613
F5J Volo (3970)	88.78	2663
Hawk F5J (3600)	87.6	2628
High End F3J (3450)	78.56	2356
Hyper AVA (pro) (3925)	92.38	2771
Infinity V (3500)	82.12	2463
Infinity X (3500)	81.79	2453
Maxa (pro) EL (3500)	81.82	2454
Maxa (pro) EL (4000)	90.14	2704
Nova F3J (3629)	88.2	2646

Orca evo (3640)	79	2370
Orca evo (3950)	82.2	2466
Orla plus (3800)	88	2640
Pike dynamic V-Tail (3700)	83.41	2502
Pike dynamic X-Tail (3700)	83.71	2511
Pike perfect (3500)	82.74	2482
Pike perfect ET (3780)	87.19	2615
Pike perfection V-Tail (3700)	83.52	2505
Pike perfection X-Tail (3700)	83.82	2514
Plus (pro) (3700)	79.2	2376
Plus X (3973)	85.18	2555
Prestige 2^{PK} (3900)	86.63	2598
Satori 1V (3600)	80.47	2414
Satori 1X (3600)	80.47	2414
Satori 2X (3805)	83.8	2514
Sense (3950)	82	2460
Shadow 1 / 2 (3654)	81.8	2454

Shinto (2995)	61.17	1835
Simitri (3841)	90.9	2727
Sirion F3J (3820)	84.11	2523
Stork 8 (3820)	82.45	2473
Super AVA (pro) (3700)	89.06	2671
Super Starlight (3820)	83.2	2496
Supra expert EL (3400)	76.2	2286
Tanga F3J (3590)	87	2610
Tortuga F3J (3510)	80.36	2410
Ultima 1 (3985)	88.81	2664
Ultima 2 (3653)	78.82	2364
Ultima 2 (3981)	84.47	2534
Vinco (3970)	92.4	2772
