



# GPS Triangle Regulations for “Light-Class” Gliders

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# 1 Definition of GPS Triangle soaring for Light Class 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. Its goal is to display cross country soaring competitions of full size soaring with our model aircraft. The main task, when participating in a GPS Triangle contest is to fly around a virtual triangle (perimeter  $\sim 0.966$  km) as often as possible in a period of 20 minutes. In order to obtain comparable results, the maximum starting altitude (**usually 250 m**) and the maximum starting speed (**usually 70 km/h**) when crossing the starting line are equal for all pilots.

The fascinating aspects of a GPS Triangle contest are:

- Lots of activities on the airfield (e.g., various model gliders flying at the same time, takeoff by hand, landing)
- 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 model 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 glider to the pilot is used. Together with the use of Data Loggers, the position (latitude, longitude and altitude) of the model glider can be determined and verified in real-time. This simplifies both the flying operations and the evaluation of the flight.

**Note: The altitude will be measured and logged by using barometric data.**

Every pilot must use commercially available navigation equipment, compatible to the specifications described in **Appendix 2**. 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, the required soft- and firmware-versions need to be installed.

Every pilot must control his model glider himself. In the case that the model glider is controlled by someone other than the pilot, the competitor will receive a zero score (0) for this 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**.

Transitionally, data sets consisting of the following flight data can be submitted for existing navigation systems:

- 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. The Noise level of the motor is logged via ENL-sensor and can detect when the motor was switched "ON".

**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 used to ensure that no errors occur when the scoring is performed "offline". In this case the information of the flight needs to be filled into scoring cards and handed to the organizer to calculate the results by using stationary evaluation software.

If "online-scoring" is used, no scoring cards are necessary and the pilots need to upload their flight-logs to a web-based scoring system. Whether "online" or "offline" scoring is performed is up to the choice of the organizer.

No check code needs to be generated if the score is calculated by the organizers after performing a validation of the flight, which was logged onto the onboard unit of the model glider in ".igc-format".

**Note:** *The navigation system and/or the navigation-application need to be able to store each flight log-data in .igc-format. (Logfile-format is described in **Appendix 2**)*

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

Penalties may be imposed by the contest director, with the consent of the Jury, for:

- Unsporting behavior
- Technical Infringements

Unsporting behavior:

Cheating or unsportsmanlike conduct, including deliberate attempts to deceive or mislead officials, deliberate interference with other competitors, falsification of documents, deleting log-files from the web-based calculation platform, from the navigation tablet and/or the onboard data-logger with the aim to destroying evidence, use of prohibited equipment or prohibited drugs, airspace violations, or repeated serious rule violations should normally be punished by exclusion from the competition. Unsportsmanlike conduct shall also be understood as a deliberate attempt by a competitor to influence, intimidate or threaten officials or other competitors or teams in order to gain an advantage over other competitors or teams - regardless of whether this occurs immediately before, during or immediately after the sporting event. This behavior may result in disqualification of the individual or team from the competition.

Technical Infringements:

Any competitor using a model glider or equipment that does not comply in all respects with the rules and regulations of the event or has not been approved by the organizer will be disqualified from the competition.

### **1.3 Use of Telecommunication Devices**

The use of any electronic device other than for piloting or navigating the model glider is forbidden. Mobile phones and other mobile devices have to be switched off or turned into flight mode on the flying site during the time the scoring flights (heats) are running.

### **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 glider. (Usually 2.0 Mio € at least or higher)

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 glider 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 model gliders head towards each other in straight line flight, every model glider 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 model gliders have the right of way. Model gliders flying in a straight line must fly around circling model gliders to avoid collisions. If a competitor circles the wrong way around, he/she must immediately change the direction of the circle after being requested to do so by the competition director or the flight operations manager. If this request is not followed as soon as possible, the flight will be scored with 0 points.
- Avoiding optical crossings of the model gliders' flight paths is mandatory
- In case of an abort of crossing the start line, a start-repetition after successfully entering the course or when turning around after missing a turn sector, these maneuvers must always be carried out with consideration for other model gliders in the air.
- Abrupt turning maneuvers must always be avoided in order not to obstruct other pilots on their flight path.
- Model gliders 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 or collision on the ground between 2 or more aircrafts.**

In case of unsportsmanlike conduct of a contestant, the contest director has the right to exclude the contestant from the contest.

## 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")

No matter how the layout of the safety zones is realized, the pilot box must be inside the boundary of a safety area at a distance of minimum five (5) meters (See sketch in 3: "flying field layout").

The minimum allowed altitude to overfly the pilot box must be 20 m AGL independent of the setup of all other safety areas.

The maximum flight altitude is 350m above the launch site - unless it is even lower due to local restrictions.

The maximum specified flight altitude may not be exceeded at any time and must be stored in the competition task-file, so that it can be immediately detected by the navigation system if exceeded. Exceeding the maximum flight altitude before, during or after the scoring flight, will result in a zero score for the pilot for that heat. No check code may be generated.

The Contest 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 as 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 model gliders 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 eight (8) m/sec. The contest has to be interrupted or the start has to be delayed by the contest director if the wind speed exceeds eight (8) m/sec measured three (3) times for at least twenty (20) seconds in a time interval of five (5) minutes approximately two (2) meters above the ground at the start area.

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

In the case of heavy and /or persistent rain the ongoing round has to be interrupted for safety reasons 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 model gliders 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 Class Model Glider and Technical Equipment

### 2.1 Definition of a Light Class Model Glider

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

## 2.2 Specification of a Light-Class-Glider

Value	Size	Tolerance
Wingspan	2700 - 4000 mm	10 mm
Surface loading ("FAI" - including the projected area of wing and horizontal tailplane)	12 - 30g/dm <sup>2</sup>	For measurement the tolerance of 1% of the maximum permitted weight is valid
Weight	max. 3000g	For measurement the tolerance of 1% of the maximum permitted weight is valid

The surface loading in general is determined by the weight of the aircraft divided by its projected wing and horizontal tail plane area. The projected surface area is defined for the state of all trailing edge surfaces (regularly ailerons and flaps) adjusted in neutral ("Zero-degree") position.

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 Model Gliders per pilot

During a GPS Triangle competition each pilot may use a maximum of two (2) Light Class model gliders or two (2) different configurations. T

These model gliders are called A-Model and B-Model. Each detachable part of the model glider which defines its outline must be marked with a distinctive identification label (for instance Model A, Model B).

This includes all parts of the fuselage including the canopy (canopies), wings, winglets and tail feathers.

Not to be labeled are joiners, Pitot- and Prandtl tubes and parts of the drive train including propellers, spinners etc.

See also paragraph 2.5.

The labels have to be documented on the starting card by the pilot and/or separately by the Supervisor of Flying (SOF). It must be documented for each flight, which Light Class model glider or model configuration was used.

## 2.4 Replacements & Ballast

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 will lead to a zero score for the aggregate heat.

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.

Changing the model glider in the current heat is only permitted if the attempt has not been completed successfully (see paragraph 4.2.3).

## 2.5 Loss of Parts

If the model glider loses a part (other than water ballast) during takeoff or in flight, the aggregate flight will be scored with zero points. This also includes unlabeled parts of the model glider (see paragraph 2.3).

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 glider to a receiving device (Ground station) and/or records relevant flight data in an onboard-logger. Additionally following requirements must be fulfilled: 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 or readout of the onboard log file.
- Only systems fulfilling the specifications (see "Appendix 2") are allowed for the flight navigation and flight evaluation.

The technical details and basic requirements for the navigation systems as well as a list of accredited systems are shown in Appendix 2.

## 2.7 Gyros, Auto Pilots & Telemetry

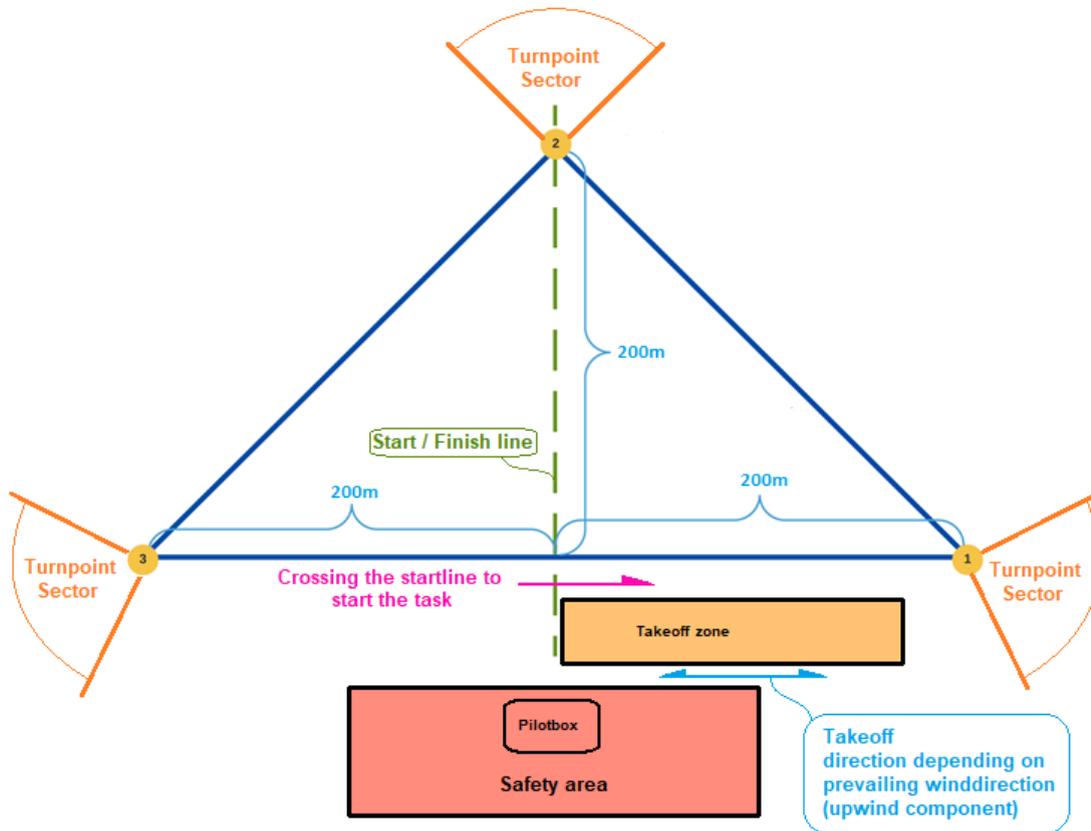
Gyros, flight augmentation systems or Autopilot systems, or the usage of data generated by such systems for flight attitude control are not permitted.

A coupling of the telemetry receiving system or any sensor system in the model glider with the remote control function (e.g. coupling of variometers/airspeed indicator and flaps, automatic flaps) is not permitted in the sense that no remote control correction signal may be sent to the model glider based on the flight-data or that the sailplane model autonomously sets or controls any functions.

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 (Launching) 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, but has to be at least minimal 5m apart of its outside boundaries.. 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 before, during or after the official scoring flight, the aggregate heat will be scored with zero points.

Launching the model gliders out of a security zone is permitted in case the launching area is placed inside a security zone.

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 heat will be zero (0) points.



## 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 (CD): 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 launching, violation of no-flight and no-landing zones and weight of the models.
- 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.

#### 4.1.2 Protests

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 model gliders, 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 **60** 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.

### 4.1.3 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.

### 4.1.4 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.

### 4.1.5 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 model glider. 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 operation of a navigation system with a frequency other than the assigned one will result in a zero score of this heat for the pilot.

In such an event the entire group is neutralized and all pilots must land as fast as possible.

The CD/SOF announces the restart of the group at the next possible time and sets a new start time window.

The causing pilot is excluded from this flight. For the group flying anew, only the score achieved after the restart of the group applies.

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.

After 6 heats (more than 5) the worst score of each pilot will be discarded (discard heat) from the overall results. For each competition the maximum number of discard heats is one (1), regardless of the number of heats flown.

### 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 **12** 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 model glider from the pilots' or his helpers' hand. Any other method of launching is not permitted. The attempt is completed when the light class model glider reaches the predefined starting altitude of the heat. The attempt is completed when the glider has left the hand of the pilot or helper.

#### 4.2.4 Repetition of an Attempt

Start repetitions are permitted without limitations within the assigned start time window and are not dependent on whether the attempt was completed or not.

However, after the first attempt, it is not allowed to replace any parts of the model glider. This applies to all mechanical parts (see paragraph 2.4), a replacement of the drive battery is permitted.

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.

**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 zero points for this heat.

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 **70 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:** Start time window in minutes depending on the group-size:

<b>Pilots per group</b>	<b>Starttime-Window in minutes</b>
<b>3</b>	4
<b>4</b>	4
<b>5</b>	5
<b>6</b>	5
<b>7</b>	6
<b>8</b>	6
<b>9</b>	7
<b>10</b>	7
<b>11</b>	8
<b>12</b>	8

The start time window is communicated by the contest director as soon as possible. Nonetheless, the start time window opens not earlier than 5 minutes after the last Light Class model glider of the preceding group has landed. If a heat consists of less than four (4) groups, the start time window opens not earlier than 10 minutes after the last Light Class model glider of the preceding group has landed. The pilots have to be ready to take off not later than 5 minutes before the start time window opens.

The Light Class model gliders need to be switched on in a designated area between Zero (0) and Two (2) meters above the ground and kept there for at least 45 seconds before taking off. This measure is taken to assure that the barometric altitude measurement is calibrated to Zero before takeoff.

The Contest Director may approve the takeoff of the model gliders 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. In the case of online evaluation, the pilot must upload the raw data digitally to the evaluation platform promptly after the flight. 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.

$$\text{Rawpoints} = \text{Triangle Points} - \text{Penalty Points}$$

### 5.3.1 Triangle rawpoints

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 proportion 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:

$$\text{Rawpoints for the last absolved triangle}_{pilot} = 200 * \left( \frac{v_{\emptyset Pilot}}{v_{\emptyset fastest Pilot}} \right)$$

$$v_{\emptyset Pilot} = \text{average speed of the according pilot} \quad v_{\emptyset fastest Pilot} = \text{average speed of the fastest pilot}$$

Hereby the average speed is calculated as follows:

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

### 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 **70 km/h**, the pilot gets penalty points as follows:

$$\text{PenaltyPoints} = 50 + 2 * (\text{Starting Alt.} - \text{Max. Starting Alt.}) + 2 * (\text{Entry Starting} - \text{Max. Starting S})$$

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 zero points for this heat.

## 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<sub>pilot</sub> = Points of the pilot

Rawpoints<sub>Best</sub> = 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.