CIACA Proposal: Solar-powered Aeroplane Sporting Code section

INTRODUCTION
by CIACA President Pierluigi Duranti.

- After the pioneeristic achievements of Paul Mc Cready and a few others, the subject of Sp-A has been brought officially to the attention of FAI when, in 1996, the international competition for "the best Sp-A" was carried out in Germany, promoted by the City of Ulm. (By the way, at that time I was leading an Italian University group which competed in that event).

- All the competing aircraft were built by individuals and/or groups of amateurs. For this reason the environment of CIACA was immediately involved

- It was immediately obvious that long time would have been necessary before Sp-A could require the definition of rules for competitions and records, but we started thinking of the future problem, encouraged by the (at that time) President of FAI, Eilif Ness. In the course of the Air Sports Presidents meeting in Rio (at which I had been invited) Eiliff Ness stated, and the other Commissions' Presidents agreed, that CIACA dealt with that subject.

- As a consequence a very preliminary action was taken by CIACA, by proposing that some initial "Definitions" for "Electrically- and Solar-powered Aircraft " were introduced within the FAI Sporting Code. I submitted our proposal to CASI and such basic set of definitions were therefore endorsed.

- Still in that line, understanding that the future frame for Electrically and SpA would require deep discussions involving those (few) who were concerned, CIACA suggested and obtained that a dedicated discussion-forum on the subject were switched-on in the FAI Web site

- Based on these initiatives the discussion on the subject has been kept alive through the years althoungh a slow development in terms of new machines took place due to limited maturity of the relevant technologies (batteries and solar-cells in particular).

- In the course of all the attempts carried out by CIACA to be part of the WAG's (and in all relevant official documents/meetings) we always put forward our proposal (accepted by everybody) to be the organizers of a dedicated competition for this emerging categories, within the WAG's.

- All activities carried out by CIACA with respect to Solar-Powered Aircraft have always been publicly described in the course of the FAI General Conferences (CIACA President reports) when present, otherwise have been reported in the written CIACA President reports.

- In the last two years, thanks to the acceleration in the performance improvements of the electrical systems , a certain revitalization of the Sp-A movement has taken place and FAI have been approached by groups which plan to perform Record flights and are asking for rules references which, at present, are not available in the FAI SC. In particular we have been addressed when Bertrand Piccard asked the FAI Headquarters to establish preliminary contacts with FAI experts in this field, in view of his initiative to aim at an around-the-world trip with an innovative Sp-A ("Solar Impulse") in the future.

- As a consequence, CIACA have taken those requests under consideration and we have accelerated the process to prepare a set of rules for Sp-A record setting to be proposed to CASI.
For more than two years we have been comparing all available SC Sections in order to take the best out of them and , without re-inventing the wheel, taking advantage of that sound experience, identifying what can be "re-used". Of course a number of specialistic new items have had to be added to be created from scratch. Properly mixing all this, we have produced a simple, possibly clear enough initial set of rules to start with. In doing this we have kept alive the discussion with the (few) existing experts in the field and have also had dedicated meetings with some of them.

- We are aware that soon one of those teams will be ready to perform a long distance flight which would be worth of a record application. On the other hand, as mentioned, the Piccard team is designing a new advanced Sp-A with the aim, in a few years, to be able to apply for an aroud-the world record . Of course, the design of the aircraft itself shall have to be be compliant with possible FAI Sp-A Class requirements. Another reason for making rules available.

- For all these reasons we have accelerated the process and, on may 10th , 2005, we have sent CASI two documents :

1) a document which explains what I have above described about the need for a new Section of the FAI SC and why it should refer to Sp AEROPLANE (and not Aircraft...). It also points out some inconsistencies found in the present SC during our thorough assessment .

2) The draft proposal for a new Sporting Code Section (Which we propose to call No. 13) , dedicated to Solar-powered Aeroplanes.

I understand that our proposal was not discussed in the course of the CASI meeting in Lausanne because I was not present to make the case for my proposal. In addition to that I understand that a number of formal points have been raised about the fact that " the Statute made no provision for Technical Commission to be responsible for Sporting Code....."

Of course CIACA and myself would find it very disappointing to discover NOW, after having been encouraged to work hard in this direction for years, that all this is not taken seriously.

But I expect that a step forward can now be taken and, in particular, for the aforementioned reasons, I would expect that it should NOT be further discussed now "WHETHER CIACA IS OR IS NOT RESPONSIBLE FOR PROPOSING SUCH NEW SC SECTION".
In my opinion, if somebody does not agree , he should have spoken earlier, in the many available occasions (e.g. GC's) in the course of past years... And if something of what the past FAI Presidents have allowed and endorsed in this respect in the past has not been fully in line with some statutes commas, they should have reacted at that time .

In the monitoring and promotional role that CIACA, since many years, are playing with respect to the emerging Experimental class of SOLAR-POWERED AEROPLANES , tight relationships with groups of interests have being developed and the subject has been technically deepened by a dedicated, specialized CIACA Sub-Committee.

In this frame, and in full respect of the FAI responsibility roles, CIACA suggests that CASI considers their proposal aimed at making the FAI Sporting Code more suitable to cope with the aforementioned incoming requirements.

Will you please take into consideration the two documents herein enclosed :

- FAI Classes.doc , which describes the reason for the need to create a new Section of the FAI Sporting code for Solar-powered Aeroplanes (not "Aircraft")

- Sporting Code Section 13 1st May 2005.doc , a draft proposal

I thank you in advance for your kind consideration.

FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE

CIACA PROPOSAL

SPORTING CODE
SECTION 13 – SOLAR-POWERED AEROPLANES

covering
FAI aircraft Class CS (Solar-powered Aeroplanes)

2005 EDITION

This amendment is valid from June 2005

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1 FAI Statutes, Chapter 1, para 1.6
2 FAI Sporting Code, General Section, Chapter 3, para 3.1.3.
3 FAI Statutes, Chapter 1, para 1.8.1
4 FAI Statutes, Chapter 5, para 5.1.1.2; 5.5; 5.6 and 5.6.1.6
5 FAI Bylaws, Chapter 1, para 1.2.1
6 FAI Statutes, Chapter 2, para 2.3.2.2.5,
7 FAI Bylaws, Chapter 1, para 1.2.3
8 FAI Statutes, Chapter 5, para 5.1.1.2; 5.5; 5.6, 5.6.1.6
9 FAI Sporting Code, General Section, Chapter 3, para 3.1.7
10 FAI Sporting Code, General Section, Chapter 1, paras 1.2. and 1.4
11 FAI Statutes, Chapter 5, para 5.6.3
12 FAI Bylaws, Chapter 1, para 1.2.2

Fédération
Aéronautique
Internationale

FAI Sporting Code

Section 13 – SOLAR-POWERED AEROPLANES

The FAI Sporting Code for Solar-powered Aeroplanes (the "Code") sets out the rules and procedures to be used to verify Solar-powered Aeroplanes (S-pA) flight performances. The essence of these rules is to ensure that a S-pA flight performance is achieved to a level of proof that is consistent for all flights. When processing the evidence supplied, Official Observers (OO) and the National Airsport Control (NAC) should ensure that these rules are applied in the spirit of fair play and competition.

In this Code, a word or phrase appearing in small capital letters within the text of a chapter indicates that it has a distinct definition as it applies to the Code. In subsequent chapters the capitalisation is not used for these words or phrases.

References outside a chapter are by paragraph number.

Text in italic is informational in nature and not part of the rules and regulations of the Code.

Amendment list (AL) record

Formal amendments are published by the FAI Secretariat, acting for the Amateur-built & Experimental Aircraft Commission (CIACA). Within nations, the organisation responsible for National Airsport Control (NAC) for SpA is then responsible for distributing amendments to all holders of Section 13 of the Sporting Code (SC13). This amendment list is for SC13 only – separate lists exist for the annexes to SC13.

A proposal for an amendment to the Sporting Code or its annexes must be submitted to the CIACA Bureau at least six months prior to the next CIACA Plenary meeting. A proposal must refer to the paragraphs affected and give reasons for the amendment. It is preferable for the proposed change to be in the format of the Code.

The Bureau will review the proposal and determine if it is “substantial” or otherwise. The Bureau will instruct the specialist sub-committee to process items that are clarifications of existing rules, or prepare discussion papers on substantial proposals for consideration at the next Plenary meeting. At the Plenary meeting, the philosophy behind a substantial amendment will be considered and set. The specialist sub-committee will then draft the Code amendment with Bureau feedback, and have it tested as required. The proposed amendment will then be published on the CIACA web site prior to the following Plenary meeting, at which time it will be submitted for final approval or rejection.

When amendments have been made to the text of the Code, a copy of the amendment list instructions should be inserted after this page so that, at a later date, the subjects of the amendment may be easily identified. Alternatively, users may download the amended Code from the document page of the FAI web site.

The latest amendments are indicated by a vertical line to the right of any paragraph that has been changed, as shown here.

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Chapter 1

GENERAL RULES and DEFINITIONS

1.0 GENERAL

1.0.1 The General Section (GS) of the Sporting Code contains general definitions and rules applying to all air sports. This Section (SC13) gives specific rules that apply to Solar-powered Aeroplanes (Sp-A) (GS 1.4 AL2 Class CS).

The maturity of this kind of aeroplanes is still quite limited and, most likely, they will remain, for some years, a small number of experimental machines. For this reason, for the time being, this section of the FAI Sporting Code deals with the record breaking rules only. Subsequent editions, when necessary, will include also rules for Sp-A competitions.

1.0.2 Terms, rules, and requirements are defined first in their most general sense. Where an exception to a general rule exists, it will be described in the paragraph of the Code where the exception occurs.

1.0.3 AIRCRAFT : A vehicle that can be sustained in the atmosphere by forces exerted upon it by the air.

1.0.4 AERODYNE : An aircraft, heavier than air, that can be dynamically sustained in the air by the reaction of the air upon surfaces in relative movement.

1.0.5 AEROPLANE : A fixed wing aerodyne with means of propulsion.

1.0.6 SOLAR-POWERED AEROPLANE (S-pA) : An aeroplane which can be sustained in level flight in the atmosphere using solely sun-light energy impacting on its airframe as its energy source. (Energy can be stored, both before flight or during flight, into on-board energy storage system)

METHOD OF PROPULSION/SOURCE OF ENERGY (MoP/SoE) : Solar-powered Aeroplanes shall not make use for propulsion, neither for any other purpose, of sources of energy different from that of sun-light impacting on their airframes and converted by their on-board photo-voltaic system. (e.g.: a “non autonomous take-off would be a reason for a S-pA to be included in the “Assisted” sub-class)

SUB-CLASS “ASSISTED”: Solar-powered Aeroplanes which, during a part of their flight not aimed at record and/or competition performance, make use, for propulsion or for any other purpose, of sources of energy different from that of sun-light impacting on their airframes and converted by their on-board photo-voltaic system.

1.1 DEFINITION of FLIGHT TERMS

S-pA FLIGHT PERFORMANCE 1.1.1 the performance during that portion of a S-pA flight from the START POINT to the FINISH POINT. Means of Propulsion/Source of Energy shall be in line with Para. 1.0.7.

WAY POINT 1.1.2 A precisely specified point or point feature on the surface of the earth using a word description and/or a set of coordinates. A WAY POINT may be a START POINT, a TURN POINT, or a FINISH POINT and has an associated OBSERVATION ZONE.

LEG 1.1.3 The portion of a flight between two successive WAY POINTS.

COURSE 1.1.4 The line joining all successive WAY POINTS of an S-pA FLIGHT PERFORMANCE.

OBSERVATION ZONE 1.1.5 The area over which an S-pA must pass to verify that a WAY POINT has been reached (see 3.6.2e). It is a 90 degree sector, having no upper limit, with its apex at the WAY POINT. This sector is:

a. For a TURN POINT, symmetrical to and remote from the bisector of the inbound and outbound LEGS of the TURN POINT,
b. For a START POINT, symmetrical to and remote from the outbound LEG,
c. For a FINISH POINT, symmetrical to and remote from the inbound LEG.

START 1.1.6 The beginning of the S–pA FLIGHT PERFORMANCE. It must be either:

a. The moment when means of propulsion and/or sources of energy different from those allowed are switched-off ("Assisted" Sub-Class only, see also 1.0.7.) or
b. Leaving the OBSERVATION ZONE of a START POINT, or
c. Crossing a START LINE.

START POINT 1.1.8 The WAY POINT marking the start of an S-pA FLIGHT PERFORMANCE. It must be either:

a. A WAY POINT declared as a START POINT, or
b. The midpoint of a START LINE.

START LINE 1.1.9 A horizontal line one kilometre in length, oriented approximately perpendicular to the first LEG. The midpoint of the line (the START POINT) is at ground level.

TURN POINT 1.1.10 A WAY POINT between two LEGS of a flight.

FINISH 1.1.11 The end of the S-pA FLIGHT PERFORMANCE. It must be either:

a. By landing the S-pA, or
b. The S-pA enters the OBSERVATION ZONE of the FINISH POINT, or
c. Crossing a FINISH LINE, or
d. Starting a not allowed means of propulsion and/or source of energy ("Assisted" sub-class only, see also 1.0.7.)

FINISH POINT 1.1.12 The WAY POINT marking the end of an S-pA FLIGHT PERFORMANCE. It is:

a. The point at which the nose of the S-pA comes to rest after landing, or

b. A WAY POINT declared as the FINISH POINT, or
c. The midpoint of a FINISH LINE, or
d. The point at which a not allowed means of propulsion and/or source of energy is started ("Assisted" sub-class only, see also 1.0.7.)

FINISH LINE 1.1.13 A horizontal line one kilometre in length, oriented approximately perpendicular to the final LEG. The midpoint of the line (the FINISH POINT) is at ground level.

1.2 DEFINITION of Sp-A FLIGHT PERFORMANCE MEASUREMENT TERMS

Depending upon the type of flight, the following parameters may be determined to assess an S–pA FLIGHT PERFORMANCE. The requirements for gathering flight measurements and the precision of measurement are given in Chapter 3.

OFFICIAL DISTANCE 1.2.1 The length of the COURSE in the sequence of the LEGS used, minus any possible applicable HEIGHT PENALTY 1.2.9).

START TIME 1.2.2 The time that the S–pA FLIGHT PERFORMANCE starts.

START ALTITUDE 1.2.3 The altitude of the S-pA above sea level at the START.

FINISH TIME 1.2.4 The time that the S-pA FLIGHT PERFORMANCE finishes.

FINISH ALTITUDE 1.2.5 The altitude of the S-pA above sea level at the FINISH.

DURATION 1.2.6 The time elapsed between the START TIME and the FINISH TIME.

LOSS OF HEIGHT 1.2.7 The START ALTITUDE minus the FINISH ALTITUDE (see also 1.4.7).

GAIN OF HEIGHT 1.2.8 The difference between the maximum altitude and a previous minimum altitude during the S-pA FLIGHT PERFORMANCE.

HEIGHT PENALTY 1.2.9 A distance equal to 100 times the excess over 1000 metres LOSS OF HEIGHT. (See 3.4.2 for how the penalty is applied.)

1.3 OTHER DEFINITIONS

OFFICIAL OBSERVER 1.3.1 The Official Observer (OO) is the person who has the official control of flights undertaken for FAI record attempts and of the data gathered to prove a S-pA FLIGHT PERFORMANCE (see chapter 4).

DECLARATION 1.3.2 The official description of the task and other data as listed and defined in 3.2.

BAROGRAPH 1.3.3 A recording device measuring external air pressure.

BAROGRAM 1.3.4 The trace, recording, or electronic data output of a BAROGRAPH.

FLIGHT RECORDER 1.3.5 An electronic device which has been approved by the CIACA to record data, including position and altitude, during a flight (such as a GNSS flight recorder).

MoP/SoE RECORDER (Sub- Class "Assisted" only)

1.3.6 A device that either:

a. Records the time and altitude of any operation of the not allowed MoP or a change in the energy consumption system configuration of the S-pA, or

b. Records the fact that the not allowed MoP/SoE is not being used. It must operate in such a way that failure of the device will indicate that the not allowed MoP/SoE is being used.

GEODESIC 1.3.7 (Also geodesic line and geodesic distance.) The shortest distance between two points on the surface of an ellipsoidal world model. See also 3.4.1.and annex C Appendix 2.

1.4 TYPES of S-pA FLIGHT PERFORMANCE

1.4.1 General requirements

a. An S-pA FLIGHT PERFORMANCE may be claimed for

- absolute altitude
- duration
- distance
- speed around the world non-stop and non-refuelled
- speed around the World (not for “Assisted” sub-class)

b. An S-pA FLIGHT PERFORMANCE may be claimed from any flight which meets the requirements of proof for that performance.

c. A DECLARATION is required except where specifically not required in the rules.

d. WAY POINTS must be declared and used in the sequence declared except where specifically not required in the rules.

1.4.2 Altitude and duration performances

No DECLARATION is required.

a. ABSOLUTE ALTITUDE
An S-pA PERFORMANCE measured for maximum altitude achieved. An absolute altitude performance is valid only if preceded by a GAIN OF HEIGHT of at least 5000 metres.

b. DURATION
An S-pA FLIGHT PERFORMANCE measured for DURATION.

1.4.3 Distance performance

The WAY POINT(S) of distance record flight performance must be declared pre-flight. The three distance record types are:

a. STRAIGHT DISTANCE
A flight from a START POINT to a FINISH POINT with no TURN POINTS.

b. OUT AND RETURN FLIGHT
A CLOSED COURSE flight having one TURN POINT.

c. DISTANCE ALONG A COURSE

A flight from a START POINT via up to three TURN POINTS to a FINISH POINT. The TURN POINTS must be at least 50 kilometres apart.

1.4.7 **Loss of height - alternate calculation for distance flights**

A distance flight (1.4 3) starting as defined in 1.1.8b (a declared START POINT) may be claimed where the LOSS OF HEIGHT (1.2.7) is measured from the start point height to the elevation of the finish point.

1.4.8 **Speed around the world non-stop**

The course, including suitable control points (to be dealt with as WAY POINTS), shall be approved in advance by the NAC's concerned (Control points shall be chosen from a pre-defined list of possible way-points). It must start and finish at the same aerodrome, crossing all meridians. The length of the course shall not be less that 36 787.559 kilometres (equal in length to the Tropic of Cancer).

If, for any reason, final landing cannot be made at the aerodrome of departure, the aeroplane may fly to an alternate landing place lying beyond the original one (at a greater distance from which the start was made).

The start time shall be the time of take-off; the finish time shall be the time of landing.

1.4.9 **Speed around the World** (Not for “Assisted” sub-class)

The course, including suitable control points (to be dealt with as WAY POINTS), shall be approved in advance by the NAC's concerned (Control points shall be chosen from a pre-defined list of possible way-points). It must start and finish at the same aerodrome, crossing all meridians. The length of the course shall not be less than 36 787.559 kilometres (equal in length to the Tropic of Cancer).

All control points must be at latitude of less than 66° 33’ (outside the North and South Frigid Zones).

If, for any reason, the final landing cannot be made at the aerodrome of departure, the aeroplane may fly to an alternate landing place lying beyond the original one (at a greater distance from which the start was made).

Intermediate landing places shall coincide with the subsequent take-off place.

Any time spent on the ground between start and finish shall be counted as flying time.

Repairs or replacements of aeroplane components and engine(s) are permitted except that the wings and fuselage may not be changed.

Pilot may not be changed during the attempt.

In the case that pilots change along the performance, another kind of record can be attributed to the specific aeroplane “team”.

The start time shall be the time of take-off; the finish time shall be the time of landing.

Chapter 2

SOLAR-POWERED AEROPLANES WORLD RECORDS

This chapter defines all the FAI world records for Solar-powered Aeroplanes and the general handling of world record claims. General rules relating to FAI records are in the General Section of the Sporting Code.

2.0 GENERAL

FAI world Solar-powered Aeroplanes record attempts require no advance notice provided that arrangements have been made for controlling the flight (4.1.2 and 4.1.3).

2.0.1 **FAI Sporting Licence**

The pilot must possess a valid FAI Sporting Licence (GS 8.1) in order to attempt and to claim an FAI world record.

2.0.2 **Records in any one flight**

Any record or records may be broken in any one flight for which the requirements are met

2.0.3 **Verification of world records**

World Records must be verified with the evidence of a CIACA approved flight recorder or with other techniques previously accepted by CIACA. (See 1.3.5).

2.1 RECORD CATEGORIES, CLASSES, and TYPES

Record categories are concerned with record classes, with the Solar-powered Aeroplane, and record types with the nature of the Solar-powered Aeroplane flight performance.

In the case of **Speed around the World record** (not for "Assisted" sub-class) performed by more than one pilot the record can be attributed to the specific aeroplane "team".

2.1.1 **Pilot categories**

There is a General category for all pilots. No Feminine category is considered.

2.1.2 **Aeroplane classes**

World records are recognised in the classes listed in 1.0.7.

2.1.3 **Designation of records**

Solar-powered Aeroplane records are designated by code letters, starting with the FAI code letter for Aeroplane (C), then the Solar-powered class (S) and, if applicable, the sub-class "Assisted" (A).

Examples: CS – Solar-powered Aeroplane
CSA – Solar-powered Aeroplane "Assisted" sub-class

Table 1

2.1.4 **TYPES OF RECORD FLIGHTS**

	Flight Performance	*Exceed old record by*	*Ref.*	*Remarks (see chapter 1 for full requirements)*
2.1.4a	Straight Distance	10 km	1.4.3a	Way points claimed pre-flight
2.1.4b	Out-and-Return Dist.	10 km	1.4.3b	Way points claimed pre-flight
2.1.4c	Distance along a course	10 km	1.4.3c	Way points with up to 3 turn points claimed pre-flight
2.1.4d	Absolute altitude	3%	1.4.2a	5000 m gain required
2.1.4.e	Duration	3%	1.4.2b	

2.1.5 **Minimum achievement for new record classes or types**
Where a new record category, class or type is created, a minimum level of performance may be set by the CIACA, which must be exceeded before a world record will be validated. It may be published in this Code, or published separately by the FAI.

2.2 TIME LIMITS ON RECORD CLAIMS

2.2.1 Notice of a claim for a world record must be submitted by either the NAC or the Official Observer controlling the attempt and must be received by the FAI within seven days of its completion as a record attempt. In exceptional circumstances, the president of the FAI Commission d'Aéronautique Sportive Internationale (CASI, the FAI Air Sport General Commission) may grant an extension. Telephone, fax, electronic mail and similar types of notification are acceptable. See the amendments page for current contact data.

2.2.2 A record attempt must be homologated by the responsible NAC as a national record within ninety days of the attempt if a world record is to be claimed, unless a longer time is permitted by the president of CASI.

Chapter 3
VERIFICATION REQUIREMENTS and METHODS

This chapter defines the evidence, measurements and calculations required to verify Solar-powered Aeroplane performances.

3.1 FLIGHT DATA REQUIREMENTS

The following is a list of all the flight data that needs to be gathered or measured to provide evidence of the completion of any Solar-powered Aeroplane performance:

a. declaration (1.3.2)
b. start point (1.1.8)
c. start time (1.2.2)
d. start altitude (1.2.3)
e. way point(s) (1.1.12)
f. finish time (1.2.4)
g. finish altitude (1.2.5)
h. maximum altitude (1.4.2a)
i. gain of height (1.2.8)
j. flight continuity (3.3.3)

Different flight performances will require different subsets of this list.

3.2 DECLARATION

For each flight, certain information is required to be recorded before the flight in order to ensure that proof of the S-pA Flight performance is available after the flight. This data, including waypoints (e) is known as the declaration. For some performances, some data is not required, but the Official Observer must ensure that all required data is recorded.

3.2.1 **Declaration content**

The information shall be written on a single sheet of paper or board, or recorded in the memory of a flight recorder prior to the flight.

a. Date of flight
b. Name of pilot
c. Type and registration of S-pA
d. Type, serial number or other identification document of barograph or flight recorder (1.3.5)
e. Way points and the sequence to be flown, start, turn(s), finish as applicable to the specific flight performance
f. Date and time of declaration
g. Signature of pilot (not required for electronic declarations)

3.2.2 **Declaration validity**

a. The last declaration made before takeoff is the only one valid for the flight.

b. If a declared turn point is abandoned, a distance along a course flight may still be claimed from the resulting shorter course provided that the turn points achieved are in the sequence specified in the declaration.

3.3 FLIGHT DATA VERIFICATION

3.3.1 Flight data collection

A barograph or device incorporating a barograph must operate throughout the flight. The barogram so produced must provide indisputable verification of flight continuity (see 3.3.3) and of all altitudes critical to the flight performance. The device may record parameters in addition to barometric pressure and time if it is suitable for the purpose (see 3.4). If data is recorded at intervals, the sampling rate setting must be no slower than once per minute.

For flight recorders, timing and pressure altitude data will be taken at the boundary of the observation zone interpolated between the times of valid fixes; or for a start or finish, this data may be taken from the fix in the observation zone which is most favourable to the pilot.

3.3.2 Landing

The landing location must be certified by one or more of the following:

a. By an OO present or arriving soon after the event and there is no doubt about the position of landing or,

b. By two witnesses (see 4.2.3c),

c. By position data from a flight recorder (but see also 3.6.4a(ii)).

3.3.3 Flight continuity

There must be evidence that the S-pA did not land or (for "Assisted" sub-class only, see 1.0.7.) no means of propulsion/source of energy different from those allowed was used during the claimed flight performance. An interruption in the barogram data will not compromise proof of flight continuity provided that the OO and NAC are convinced no critical data is missing and that the evidence for flight continuity remains indisputable.
In the event of failure of the pressure altitude recording in a flight recorder, evidence of flight continuity may be assessed from a time plot of GNSS calculated altitudes provided the rule on the setting of sampling rates is followed (3.3.1).

3.3.4 Altitude

Absolute altitude, gain of height and start altitude must normally be verified from atmospheric pressure data recorded by a barograph. External measurement (see 3.7.1) may be used only when the required accuracy can be verified.

3.4 CALCULATIONS and CALIBRATIONS

Time, geographical position, altitude, and means of propulsion/source of energy are flight performance data which must be either recorded or measured for some or all types of flights. Using this data, calculations of distance, duration, gain of height, altitude difference, height penalties and start height may be done.

3.4.1 **Calculations for distance and speed**

For world records, distances between two points in excess of 1000 kilometres, and in any case of dispute over a distance, the distance flown is deemed to be the length of the geodesic line joining the start point and the finish point or, if there are turn points, the sum of the geodesic lines for each leg of the course.

a. EARTH MODEL TO BE USED

For the purpose of the calculation of FAI geodesic distances, the WGS 84 earth model shall be used.

When calculation of the exact distance is not critical, less accurate methods may be used.

b. GEOGRAPHICAL COORDINATES OF WAY POINTS

NACs are to specify procedures for recording the geographical coordinates of way points from maps of their national territory using geographical co-ordinates such as Latitude and Longitude, map grid, or national grid (if such a grid exists for the area concerned).

c. MAP SCALES

Measurement of co-ordinates of way points should be from a map with a scale at least as detailed as 1:250,000, and preferably 1:50,000 (if such a map exists which includes the way point concerned). If a scale less detailed than 1:50,000 was used, the NAC should be able to show that co-ordinates were taken from the most accurate map available for the way point concerned.

3.4.2 **Loss of height and application of the height penalty**

a. For distance flights of more than 100 kilometres, where the loss of height (1.2.7) exceeds 1000 metres, a height penalty (1.2.9) must be subtracted from the length of the course to give the official distance.

b. For distance flights of 100 kilometres or less, a loss of height exceeding 1% of the length of the course will invalidate the flight performance.

c. For duration flight a loss of height exceeding 1000 metres will invalidate the flight performance.

3.4.3 **Flight data requirements**

The minimum flight data required for each type of flight performance is given in Table 2.

Table 2 **Minimum data requirements**

Flight Performance	Measurements				Calculations	
	Time	*Position*	*Height*	*MoP/SoE*	*Distance*	*Height*
Distance	x	x	x	x	x	x
Duration	x		x	x		x
Altitude	x		x	x		x

3.4.4 **Accuracy of measurement**

The minimum accuracy of measurement and calculation required for each type of flight data is given in Table 3. Any inaccuracy in a measurement or calculation is to be interpreted to the maximum disadvantage of the pilot.

Table 3 **Minimum accuracy requirements**

Flight Performance	Measurements				Calculations	
	Time	*Position*	*Height*	*MoP/SoE*	*Distance*	*Height*
Distance	1 min	500 m		active	1 km	30 m
Duration	1 min			active		30 m
Altitude	1 min		1%	active		10 m

Precision of measurement

Care should be taken to correctly assess the precision of measurement devices so that an invalid level of accuracy is not introduced into calculations.

3.4.5 **Combinations of measurement methods**

Any combination of the measuring methods is acceptable for the various types of flights, provided the minimum requirements for accuracy of equipment in paragraphs 3.4.3 and 3.4.4 are fulfilled.

Each method used must comply with this Code as if it were the only means of proof employed.

3.4.6 **Timing device calibration**

When used, clocks and other time recording equipment shall be checked against official time signals both immediately before and again after the flight, covering a period of at least three hours. Any error found shall be taken into account and rounded up in the calculations. The GNSS time recording from a flight recorder may be used as an official time signal.

3.4.7 **Barograph calibration period**

Barograph calibrations are required to ensure that the measurement of barometric pressure and time are checked against, and corrected as necessary, to official standards. For records, both (a) AND (b) calibrations below are required, and the least favourable calibration of the two shall be used making the calculations for the record.

a. PRIOR TO THE FLIGHT
The calibration used must have been performed within 12 months prior to the flight or, for CIACA-approved electronic barographs and flight recorders, 24 months.

b. AFTER THE FLIGHT
The calibration used must have been performed within one month after the flight.

3.4.8 **Calibration correction**

When absolute altitude (not altitude difference) is to be determined, the altitudes reached during a flight from the barograph evidence must be corrected for a height error arising from the actual atmospheric pressure of the day compared to the standard atmosphere.

3.5 TIME MEASUREMENT and EVIDENCE

3.5.1 **Time measurement**

Time data requirements may be fulfilled by any of the following measuring methods:

a. By direct observation from the ground by an observer with direct access to approved time measuring equipment (e.g. a synchronised timepiece). If a time-piece displaying only minutes is used, 59 seconds is to be added to each duration measured to allow for the possibility that the reading was taken just before the minute changeover. Pilots and OOs should use timing devices with outputs in seconds whenever possible.

b. With a barograph, to measure time differences,

c. With a time camera, to measure time differences (except for duration flights),

d. A recording device with correct real time input, such as a flight recorder.

3.5.2 **Time evidence**

a. Evidence of timing and time recording of flights must be under the control of an OO. Time recording equipment carried on board a S-pA must be capable of being physically or electronically sealed and, where a human action is required, shall be sealed and unsealed only by the OO.

b. The equipment must be positioned so that the time parameters cannot be altered by the pilot or passenger during the flight.

c. If a means is provided for the pilot to make inputs into a device for remote recording of flight events, such inputs must be confined to functions not critical to the validation of the flight.

For example, it is permissible for a pilot to make a mark on the time base to register an event such as a particular position, or in GNSS systems to change the sampling rate in flight.

3.5.3 **Night flight**

In the case of a flight which continues beyond the hours of legal daylight in the country concerned the Solar-powered Aeroplane and pilot shall comply with the laws of that country for night flight or a specific dedicated permission shall be obtained.

3.6 POSITION MEASUREMENT and EVIDENCE

3.6.1 **Position measurement**

Flight position data requirements may be fulfilled by any of the following measuring methods:

a. By direct observation from the ground for start, turn, and finish points,

b. Satisfactory photographic evidence from a camera in the S-pA;

c. Satisfactory data from a flight recorder in the S-pA.

3.6.2 **Position evidence – general**

a. CROSSING A START LINE

(i) When the start line is controlled by observation from the ground, visual observation of a crossing in the direction of the first leg at an altitude of not more than 1000 metres above the line.

(ii) When using flight recorder evidence, by clear proof that the start line was crossed in the direction of the first leg.

d. CROSSING A FINISH LINE

(i) When the finish line is controlled by observation from the ground, the nose of the Solar-powered Aeroplane crosses the finish line unassisted from the direction of the last leg at a height of not more than 1000 metres above the line.

(ii) When using flight recorder evidence, by clear proof that the finish line was crossed from the direction of the last leg.

e. WAY POINTS

Way points should be of such a nature that they are easily recognisable from the air. Where photography is used, way points shall be point features and should be selected to make interpretation of photographs easy, even on photographs taken in difficult light conditions such as low contrast. Where a flight recorder is being used for verification, the way point co-ordinates do not need to represent a point feature on the ground.

f. OBSERVATION ZONE

Evidence is required that the S-pA was within the observation zone (1.1.5) of a way point used during the flight. This may be collected by using one or more of the following three methods:

(i) Direct observation, in which the S-pA is positively identified as being within the observation zone by an OO on the ground at the turn point. Magnification and tracking devices may be used.

(ii) Photographic, where the pilot presents a satisfactory photograph taken from within the observation zone in accordance with the rules for photographic evidence below.

(iii) Flight recorders, where (in accordance with the CIACA rules for the use of this equipment (see 3.6.4)), the data record shows incontrovertible proof that the S-pA was in the observation zone, with one position fix recorded either exactly on the position of the waypoint or within the observation zone, or else a straight line drawn between two consecutive valid fixes crosses the observation zone.

3.6.3 **Photographic position evidence**

Photographs can be used to prove evidence of position and generally substantiate the S-pA performance by means of a sequence of photographs on a single length of film. There shall be proof that all pictures were taken from the aeroplane on the flight concerned and that turn point(s) were photographed between the start time and finish time.

a. PHOTOGRAPHIC CONTROL METHOD

The following method shall be used:

(i) Mounting in the cockpit

The camera must be held in fixed mountings in the cockpit so that every photograph will show the wingtip. The lens housing should be positioned inside the canopy or camera window so that the random line mentioned in (iii) below will show on the film.

(ii) Sealing the camera

The camera must be sealed unless the same OO is controlling both the pre-flight photograph(s) and the processing of the film, in which case sealing is not necessary. When a time recording camera is used to supply time evidence, it must be sealed by an OO before the flight in such a way that the film cannot be removed and the time adjusting mechanism cannot be accessed until the seal is broken by an OO after flight.

(iii) Before takeoff

Just prior to takeoff an OO shall mark the outside of the canopy or window across the front of the lens with a random line and display the flight declaration for the pilot to photograph with the camera installed.

The random line should be dark or opaque and at least 3 mm wide if it is to show on the image.

(iv) After flight

Following landing and the completion of the photographic sequence, an OO shall take charge of the film and have it developed. Every effort is to be made to preserve the film as a continuous strip. However, if it is cut or broken while out of control of the pilot or OO, this evidence remains valid if close examination of the pieces show that they form the original continuous length of film. An OO shall describe the circumstances under which the film was broken or cut.

b. PHOTOGRAPH SEQUENCE

The film shall contain photographs in the following sequence:

(i) the pre-flight clock synchronisation photo(s) if a time camera is used (see 3.5.1c and 3.5.2a),

(ii) the declaration,

(iii) at least one photograph showing indisputable evidence of the presence of the Solar-powered Aeroplane in each of the observation zone(s) of the way point(s) used, in the correct sequence,

(iv) the S-pA on the landing field with surrounding features and its registration markings appearing clearly on the photo, or the above declaration with landing time added.

(v) the post flight synchronisation photo(s) if a time camera is used.

Photographs in (ii) and (iii) above must show the shape of the canopy mark (see 3.6.3a(iii)) on the film image. Additional photographs which may have been taken after the declaration and before the landing must also show the canopy mark.

3.6.4 **Flight recorder (GNSS) position evidence**

All flight recorder evidence must be produced by an FAI/CIACA approved system. The WGS84 Geodetic Datum shall be set for all Lat/Long data that is recorded and transferred after flight for analysis.

a. FLIGHT RECORDER CONTROL METHOD

The OO shall familiarise himself with the terms of the approval for the GNSS and flight recorder equipment concerned. There must be incontrovertible evidence, independent of the FR data, that the FR from which the flight data was taken was in the S-pA flown by the pilot during the claimed flight performance.

(i) Before the flight

The OO shall sign the pilot's written flight declaration, except where the declaration is stored electronically in the flight recorder (1.3.2). The OO shall enter a secret code into the flight recorder if the CIACA approval for the equipment requires this. The flight recorder system shall be placed, configured or sealed in such a way that it will be physically impossible to operate any controls other than those specifically allowed for use in flight; and to connect or disconnect any device to the flight recorder system other than in accordance with the CIACA approval for the equipment. The method(s) of sealing, if any, shall be specified in the CIACA approval for the equipment.

(ii) Takeoff and landing

An OO shall ensure that there is evidence for the times and points of takeoff and landing, pilot(s) names, aeroplane type and registration, and the type and serial number of the FR for flight evidence. This evidence shall be independent of the data produced by the FR.

(iii) After flight

After landing, the flight data shall be transferred from the FR to a diskette via a PC or other device in the manner specified in the CIACA approval for the

equipment. The OO shall check any seals which were applied before the flight. The diskette containing the flight data shall then be sent to a person approved by the NAC to make the analysis.

b. DATA ANALYSIS

The analysis of the flight data shall be performed by a qualified person approved by the NAC, whose duty is to ensure that the appropriate evidence is present to verify the attainment of way points, heights, times and position, as required. If the flight performance qualifies for a record, the following shall be forwarded to the NAC:

(i) The original data diskette (the first copy) storing the flight data. This must include the data file in the CIACA recommended format, and the file in its original format
(if different) as transferred from the flight recorder immediately after landing.

(ii) The appropriate claim form(s), including OO's evidence that manually recorded times and exact locations correspond to the equivalent flight recorder data.

(iii) For record flights, the achieved way points shall be determined from the flight recorder evidence and specified in the claim for the record. The flight recorder "pilot event marker", if incorporated, may be used to indicate the desired waypoint position(s).

(iv) Any other measured data and/or auxiliary material required by a NAC to support the mandatory evidence.

3.7 ALTITUDE EVIDENCE and CONTROL

3.7.1 Altitude evidence

Altitude data requirements may be fulfilled by any of the following measuring methods:

a. A barogram,
b. Optical measurement from the ground (e.g. a suitable height frame or theodolite),
c. Radar measurement from the ground,
d. For continuity of flight purposes only, the GNSS altitude output of a flight recorder.

3.7.2 Altitude control methods

For altitude recording other than by external measurement, a barograph or flight recorder must be carried in the aeroplane. Any marking of the barogram during flight shall be done by remote control, not by direct access to the barograph itself. The barograph shall be placed in the SpA in such a way that no part of the barograph is accessible to the pilot or passenger during the flight.

The pressure altitude recording system in a flight recorder is a barograph and must comply with other rules in the Code for barographs and their calibration. Altitude control methods for flight recorders are the same as those used for position evidence (see 3.6.4).

a. BEFORE TAKEOFF

(i) Mechanical barographs

The OO shall make an identification mark on the barogram paper/foil and then seal the barograph.

(ii) Electronic barographs
The OO shall seal the barograph and then enter a secret multi-character code into the barograph memory before flight (a second entry of this code shall be required to retrieve the stored data). This step is not required if the barograph stores continuous date and time data which cannot be altered without the fact of such alteration being automatically reported on all data printouts from its memory after such alteration, and the OO is able to verify the date and time of the takeoff and landing of the S-pA on the flight concerned.

b. AFTER THE FLIGHT

(i) The OO shall take control of the barograph, and ensure that its seal is secure and that the barogram has the identification mark placed on it prior to takeoff. The information required in paragraph 5.1 may then be added to the chart.

(ii) For electronic barographs, an OO must either supervise the transfer or printing of data from the barograph while it is in the S-pA, or supervise the removal of the electronic barograph from the S-pA and shall then take charge of it until the flight data is printed out. The OO then confirms that the date and time on the printout is correct and that the date and times of the altitudes and other flight data recorded and printed out correspond to the date and times of the flight concerned, and correspond with other relevant aspects of the claimed performance.

3.8 MEANS of PROPULSION/SOURCE of ENERGY EVIDENCE and CONTROL (Sub-class "Assisted" only)

3.8.1 Means of propulsion/Source of Energy evidence

The requirement to record data on the use of any not allowed MoP/SoE may be fulfilled by any of the following methods:

a. The data is recorded by a MoP/SoE recorder, or

b. by direct observation from the ground that the MoP/SoE has stopped, provided that there is no means of restarting it (for instance Aero-tow, car-tow etc.), or

c. by a seal applied to the MoP/SoE in such a way that the generation of forward thrust by the MoP or the use of the SoE always results in breaking the seal.

3.8.2 MoP/SoE control methods

a. With the use of an MoP/SoE recorder:
The MoP/SoE recorder must be sealed and opened only by an OO, and must not be accessible to pilot or crew during flight, except where it is a CIACA approved flight recorder operated in accordance with the CIACA approval.

b. Without the use of an MoP/SoE recorder:

(i) Before takoff, the MoP/SoE may be sealed by an OO as in 3.8.1c (and the OO shall certify that the seal was intact after landing), or

(ii) The MoP/SoE may be rendered unusable by removing an essential part of the system (and the OO must certify that this was done.

Chapter 4

OFFICIAL OBSERVERS

4.1 AUTHORITY

4.1.1 **Official Observer appointment**
OO are appointed by a National Airsport Control (NAC) on behalf of the FAI and CIACA.

4.1.2 **OO duties**
The OO shall, as the FAI and CIACA representative, control and certificate the record flight performances:

4.1.3 **Control and certification**

a. CONTROL is the observing of takeoff, start, finish and landing and, where applicable, the timing of individual events such as declarations, sealing, installation, removal and unsealing of barographs, flight recorders and cameras, means of propulsion/Source of Energy recorders and other devices.

b. CERTIFICATION is the checking of evidence and signing of appropriate certificates covering the evidence concerned.

4.1.4 **Competence**
OOs must be knowledgeable in the Code and have the integrity, skill and competence necessary to control and certificate S-pA flights without favour. Before being approved by the NAC, the OO should be given briefing or training appropriate to the duties of an OO.

4.1.5 **Geographical area of authority**
OOs are entitled to control and certificate flights of S-pA in:

a. The country of their own NAC, and

b. In any country and for S-pA pilots of any nationality, if the country's NAC so permits.

4.1.6 **Conflict of interest**
Official Observers may not act in such capacity for any record attemp
In which they have any financial interest.

Ownership of the S-pA shall not be considered "financial interest". The essence is that monetary or other substantial gain shall not depend on the successful certification of the claim by the OO or other individual concerned.

4.1.7 **Violation of duty**
In case of violation of duty, the appointment of the OO shall be withdrawn. In addition, negligent certifications or wilful misrepresentations are grounds for disciplinary action by the NAC concerned.

4.2 CERTIFICATION OF EVENTS

4.2.1 General

a. The date, times and points of takeoff and landing on the flight concerned must be verified, and there must be evidence that recording devices used for flight evidence were in the S-pA concerned during the flight.

b. Record and badge flights shall be certificated by the OO by completing and verifying the information in the official FAI record claim forms or, for national records or badge performances, claim forms containing similar information (see 5.4).

4.2.2 OO presence at the event

OOs may certificate individual events (such as sealing and breaking seals, installation and removal of equipment, takeoff, timing at start and finish, landing, etc.) if they were present at the event for which certification is required, or are able to satisfy themselves either through evidence from persons who witnessed the event or from other reliable sources. Evidence from air traffic control or club flying logs may be used. Barometric pressure may be obtained from the log of a nearby meteorological office.

4.2.3 Certification by non-OOs

a. Certification of events by people other than OOs must be countersigned by an OO after verifying the statements.

b. Air traffic controllers on duty may certificate observations of takeoffs, start and finish lines, turn and control points and landings.

c. Possible outlandings may be certified by two independent witnesses who give their names, addresses, and preferably telephone numbers, if any (see 5.2).

Chapter 5

CERTIFICATES and PROOFS

5.0 GENERAL

All certifications and calibrations must clearly relate to the flight, event, or equipment being certified or calibrated, and include the date of the certification/calibration, the signature of the person doing the certification/calibration and, where applicable, the OO's signature. Each separate sheet of paper must have this identification. Diskettes or other electronic memory devices storing flight or calibration data must be labelled clearly.

5.1 BAROGRAM

Except as permitted for flight recorders and electronic barographs (see 3.6.4 and 3.7.2), a barogram shall have the following information clearly registered on it:

a. Identification mark of OO before takeoff,
b. For altitude records, the pressure at ground level (QFE) at time of takeoff,
c. Date of flight,
d. Name of pilot,
e. Type, serial number and altitude range of barograph,
f. Type and registration of S-pA,
g. Proof of no intermediate landing,
h. Date and signature of OO after landing.

5.2 LANDING CERTIFICATE

The landing certificate shall state precisely the location of the landing place and the time of landing.

5.3 BAROGRAPH CALIBRATION CERTIFICATE

The barograph calibration certificate shall include:

a. Type, serial number and altitude range of barograph,
b. Date of calibration,
c. Calibration trace, graph or table,
d. Date, name and signature of calibration laboratory official.

5.4 TIMING DEVICE CALIBRATION STATEMENT

The timing device calibration statement shall include:

a. Type and serial number of timing device used,
b. Description of method for (and result of) calibration of the timing device (3.4.6),
c. Date and signature of OO or calibration laboratory official doing the calibration.

5.5 FAI RECORD CLAIM FORMS

For claims submitted to the FAI, the current FAI Official Claim Forms approved by CIACA must be used. For national claims, the NAC may issue its own forms similar to the FAI versions. When submitted to the FAI, the pages of each form should be printed on one sheet of paper such as by using back-to-back printing on A3 size paper (or 11" x 17" paper in North America).

Designation	Record type	Remarks
Form A	Absolute Altitude	
Form B	Distance	
Form C	Duration	
Form E	Completed by all NACs involved	Must be included with claim file.

The FAI forms are available from the CIACA web site <http://www.fai.org/XXXXX >, and in hard copy from the FAI office and NACs.