Technical regulations for

The Sun Trip 2018

Preamble

This "Technical Regulations" document is provided by the organization to serve as a guide for the design of solar bicycles for the Sun Trip 2018 Edition and ensure fairness between participants. Its content is written in good faith and must be interpreted as such. Amendments may be issued by the organization to clarify or adjust minor elements of design or modalities for technical inspection.

The more general “Adventure Regulations” is published separately.

1. Overview

The Sun Trip is an experience of freedom starting from the solar bicycle’s design. Participants are free to develop their bike themselves or to get help from experts or professionals. However, participants must follow the regulations set out in this document, Regulation that, as well as all other instructions that the organization may have to state.

Participants must under no circumstances be followed by a technical team during the journey. In case of technical problems, they must fend for themselves, relying on the help of the people encountered. The Technical Committee may, however, allow for special facilities to accommodate disabled participant or for medical reasons.

Participants are allowed to be in touch with their team or technical advisor by phone or via Internet. Sending spare parts further on the course will also be allowed, as detailed in the Adventure Regulations.

A preliminary technical inspection will be carried out about three months before departure via a Technical logbook to be completed and handed to the Technical Committee.

A few days before departure, the Technical Committee will conduct a compliance check on all machines. Other compliance checks may also take place during the adventure or upon arrival.

The organizer can not be held responsible for any problems that may be caused by a solar bicycle before, during or after The Sun Trip 2018 event.

2. Types of Cycles

2.1 Cycles

The Sun Trip is open to a variety of human-powered vehicles : upright and recumbent bikes, upright and recumbent tricycles, hand-bikes, tandems and velomobiles.

The cycle cannot be fitted with more than 3 wheels, excluding the trailer.

Teams may choose to equip one solar bike per person or to use a tandem. Unless otherwise indicated, the technical specifications of these Regulations apply to each machine individually.

2.2 Trailer and Definition of a Machine

The bike may be equipped with a trailer, designed with no more than two wheels. A cycle and its eventual trailer are what we define as a “machine” hereafter.

2.3 Dimensions

Overall, the machine may not be over 99 cm in its riding configuration. There is no maximal width for the machine when it is stopped.

2.4 Bodywork and Fairing

The bike may be equipped with an aerodynamic fairing, provided that the face of the pilot remains exposed (i.e. not enclosed in a cockpit).

2.5 Brakes

The cycle must be equipped with at least two distinct braking systems impacting on two wheels.

3. Electro-Solar System

All bikes shall be equipped with an electrically assisting engine, batteries (one or more) and solar panels. Pedals should however remain as a means of propulsion and the crankset must physically linked to a wheel of the cycle via a chain, strap or universal joint.

3.1 Engine

Bikes shall be equipped with up to one engine per person. Tandems may therefore chose to use two engines, but it is not mandatory.

Participants are free to choose what type of electric engine they wish to use. Electric assistance may be triggered by a pedal sensor and/or an acceleration throttle.

The engine chosen should not be able to assist the bike beyond 45 km/h by design. To reduce the risk of fraud, electronic clamping is not deemed an acceptable way to limit the maximum speed, except for Speedpedelec bicycles (licensed for 45 km/h).

In order to calculate the maximum assist speed of the engine, the following calculation must be performed:

a. For hub engines

RPM/Volt × Rated voltage of the battery × Wheel circumference × 60

Hub engines may be fitted with an energy regeneration system. A separate generator that can be used as an engine without major modification will be counted as an engine. 6V rim or hub dynamos for lighting or small electronics are not considered as an engine.

b. For non-hub engines (crank drive, geared)

RPM at the axis of the wheel with the largest gear ratio × Wheel circumference × 60

For bottom bracket motors, the crankset must include a freewheel mechanism, separating the cranks from the rotation of the chainrings, thus avoiding any risk that the pedals get in motion when switched on.

3.2 Batteries

To keep some consistency and equity among participants, the overall batteries capacitance should not exceed 1100 Wh per machine (including any backup battery). This limit applies to all bikes, be they straight or recumbent, trikes and tandem. The determination of the battery capacitance will be calculated by multiplying the typical capacity and voltage values of the cells as per the manufacturer's datasheet. A tolerance of 5% (55 Wh) will be accepted in the calculation on the basis of the variability of battery pack technologies.

Calculation example:

Sony UST18650V3 Lithium-Manganese cells (3.7V, 2250mAh)
13 in series, 10 in parallel (13S10P)

3.7 V × 13 cells = 48.1 V
48.1 V × (2.25Ah × 10 cells) = 1082 Wh

LiFePO4 A123 26650B cells (3.3V, 2500mAh)
16 in series, 8 in parallel (16S8P)

3,3 V × 16 cells = 52.8 V
52.8 V × (2.5 Ah × 8 cells) = 1056 Wh

This capacitance can be divided among several batteries. Lithium batteries must be equipped with a battery management system (BMS) adapted to the battery pack, to manage high and low voltages.

The maximum nominal battery voltage is 51.8 V. This means : 14 cells in series for LiPO, LI-NMC and Li-NCA (3.7V × 14), 16 cells in series for LiFePO4 (3.3V × 16).

Battery voltage when full shall not exceed 60 V.

Participants are free to choose whichever type of battery they wish to use. However, they must be informed on the inherent risks for each type of technology and take responsibility for their choice in case of problem (explosion, fire…). In addition, batteries must be adequately protected against weather and shock damage using a flexible foam or hardshell case.

The system must be fitted with an easily accessible manual circuit breaker and a suitable fuse. A plug and socket connector is acceptable.

3.3 Solar Recharge

Participants are free to design their solar cells, panels and support however they wish. Several panels can be stacked for transport.

When the vehicle is moving, a minimum of 100 Wp (minimal surface 0.5 m²) and a maximum of 450 Wp (maximal surface 2.5 m²) photovoltaic cells must be visible at all times on the cycle and/or the trailer.

Participants are allowed to stack solar cells that can be deployed while stopped. Total wattage of all carried cells should not exceed 900 Wp, with no surface limitation.

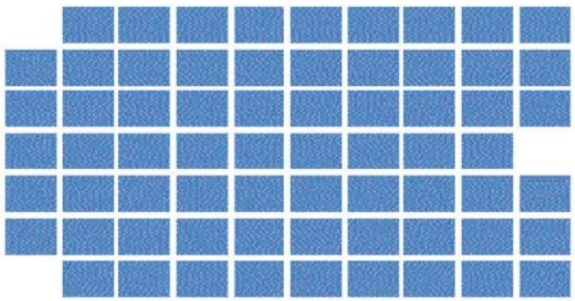
A 0.55m² / 100 Wp bonus is conceded to tandems, and may be visible at all time or when stopped, on the bike or on the trailer.

Solar panels tension is limited to 60 V for safety reasons.

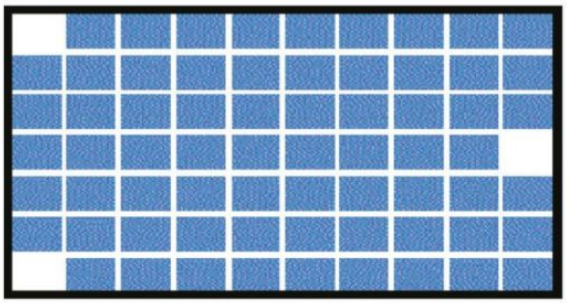
Total power will be calculated according to manufacturer specifications in the technical logbook, a surface calculation from cell to cell, excluding the edge of the panels.

In the case where several panels are used, the total surface is the sum of individual panels envelope surfaces. When cells are not arranged in a rectangular way, the envelope surface will be used.

Example :



Photovoltaic cells layout



Envelope surface

Panels on the vehicle may not exceed 100 cm beyond the front wheel axle.

The electro-solar system must include a charge controller between the panels and the battery, suitable for the battery pack technology and voltage.

Solar panels should have visible markers such as reflective tape on each angle. We recommend dulling the corners and protecting sharp edges of the panels and structure.

3.4 Measurement Tools

All vehicles must be equipped with two wattmeters (Cycle Analyst, Battman, hobbyist wattmeters, etc..) in order to measure daily solar output and power consumption. Measures will be recorded every day by participants and sent to the Technical Committee in a way to be specified later

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These measurements will ensure effective monitoring of the 100% solar challenge, in addition to obtaining useful and pedagogical statistics for continuous improvement of solar technology bicycles.

3.5 Mains Charger

The Sun Trip is a solar bicycles adventure. Solar charging must be functional at the time of departure. All participants should make a reasonable effort to live this adventure using only solar energy.

However, in case of solar charging failure or of an exceptional situation, participants are allowed to finish the course with the help of a mains charger. The use of this emergency charger will automatically disqualify the participant from the solar race and will be detrimental to the Solar Adventurer challenge.

An emergency charger can therefore be carried by participants. Its dimensions should be less than 25 x 15 x 10 cm. It will be sealed in a way that will be kept secret until departure day.

4. Mandatory Accessories

4.1 Mirrors

Every bike must be fitted with at least one mirror.

4.2 Lighting

Every bike must be fitted with front and rear lights that may be connected to the battery or run on separate batteries. Participants should also have a second emergency rear light, running on separate batteries.

4.3 Camping Equipment

Participants must carry a tent and a sleeping bag with them. For pairs and trios, one tent is sufficient per team. It is recommended to carry proper equipment in order to camp safely.

4.4 Race Plate and Sun Trip Partners Visibility

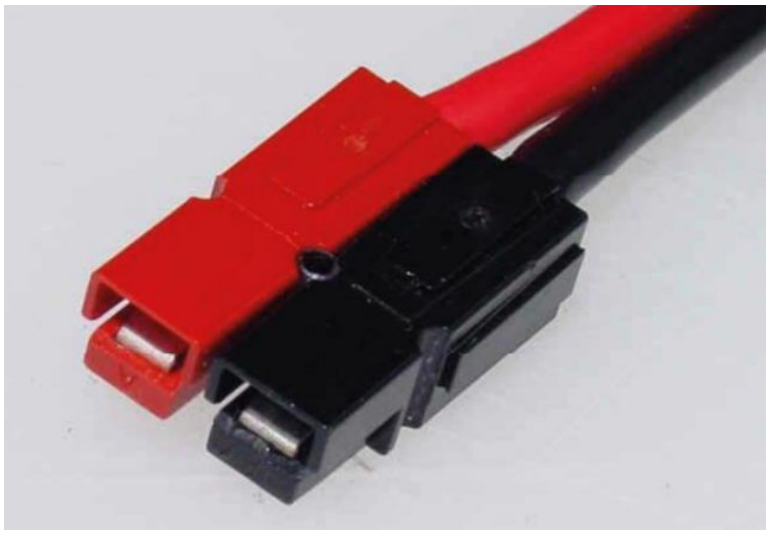
Participants are required to reserve a space for the race plate (23 x 16 cm) that will be handed to them. The plate shall be attached to the handlebars or handlebar bag on upright bicycles. On recumbents, participants shall find a visible spot in agreement with the Technical Committee. The plate will display the team name, the Sun Trip logo and official partners of the adventure.

Participants may also give visibility to their own partners on their bikes, excluding on the race plate.

4.5 GPS-positioning beacon

Participants are free to navigate the rally using a GPS or simple maps.

Participants will be provided a GPS-positioning beacon that they must maintain in working order throughout the adventure. It will be battery-powered. Participants must provide a proper connection from the battery using Anderson connectors (see photo).



These connectors will be placed in a way such the beacon can be installed in the vicinity, in order that most of the sky and GPS satellites may be visible.

5. Technical Inspection

Participants will be required to a logbook/data sheet detailing their technical choices such as the motor specifications (make, model, RPM / Volt, etc), batteries, solar panels and more generally the dimensions of the bike. The technical logbook should be returned to the organizers by email **between February 15 and March 15**, supported by photographic evidence when necessary. Delays in sending the logbook may result in exclusion from participating in Sun Trip.

A few days prior to departure, a real-life verification of the vehicle will be done by the Technical Committee. This verification may be renewed at any time on the course.

A formal policy will clearly define a range of penalties for rules infringement and a jury will be responsible for enforcing them.

Technical Regulations up-to-date on Sept. 17, 2017