Spring 2023 Competition

Rules and Regulations

Florida Gulf Coast University

Whitaker Center for STEM Education
U.A. Whitaker College of Engineering

TABLE OF CONTENTS

WELCOME

Thank you for your interest in the Florida Gulf Coast University (FGCU) SunChase Event!

In 2013 Dr. Joe Simmons, the first Backe Chair for Renewable Energy at FGCU had a vision to develop area high school student interest in engineering and renewable energy technologies through a solar go-kart competition held on campus. Since that first year the FGCU Faculty, Students, and Staff have worked hard to host and promote this event, and we hope to continue to work with each of you to continue to improve SunChase every year!

This booklet provides the 2023 of rules and regulations for the teams, to guide the construction and development of your go-kart so that it conforms to our guidelines by race day. While safety is our first priority, we want teams to learn and enjoy as much as possible during the year and while visiting the Florida Gulf Coast University campus this spring.

Have fun and be safe!

The SunChase Team –

Derek Lura, Associate Professor, College of Engineering

Julie Rose, Outreach Coordinator, College of Engineering

Heather Skaza-Acosta, Interim Director, Whitaker Center for STEM Education

Derek Buzasi, Whitaker Eminent Scholar, College of Arts & Sciences

SAFETY & RESPONSIBILITY

The FGCU SunChase is an opportunity to learn about solar power, electric vehicles, and engineering skills as part of an exciting race event. The SunChase go-karts are typically capable of speeds that exceed 30 MPH and have high power electrical circuits. Our first priority is safety. Safety is everyone's responsibility. We have provided a minimum set of safety standards for the go-kart in this rulebook, but ultimately safety is up to you. Please use proper safety procedures when preparing on your go-karts, especially in regards to the electric circuitry and mechanical drive components. On race day, we expect all participants to follow the rules in this guide and all additional safety instructions provided for the event. In addition, on the racetrack your decisions effect all of the other participants, so be mindful of your actions. We encourage all of the race participants to contribute to safety, so please let us know your suggestions and concerns.

KART REQUIREMENTS

The SunChase go-karts are battery and solar panel powered electric vehicles. For new teams we recommend the starting with a pre-built chassis as it will better ensure the structural stability of the kart. You may however, use any chassis and parts that meet the following requirements.

Overall Go-Kart Configuration

The placement of solar panels on go-karts may lead to a top-heavy vehicle, so please pay special attention to cornering and stability of the vehicle.

- Go-karts must have a minimum of 4 wheels.
- No trailers, folding panels, or other non-ridged attachments are allowed.
- The driver must operate the vehicle in a seated position.
- A 5-point seat belt harness must be used.
    - Harness straps must be secured to the fame of the vehicle, or other structural member, at appropriate locations that are consistent with the manufacturer's specifications.
- At least one mirror must be mounted to allow the driver to see behind the vehicle.
- A horn must be present and easily accessible by the driver.
- A break light must be mounted near the center of the back of the kart and clearly visible from the rear.

Dimensions and Weight

- Minimum track (center to center distance between the tires, Figure 1) is 0.8m, (31 in).

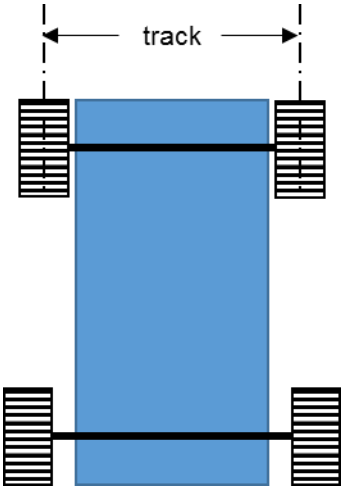

Figure 1. Top-view of go-kart showing track measurement.

- Maximum width of the vehicle and all attached accessories at any point is 2.00m (6.56 ft).
    - It is recommended that track distance be greater than 50% of the max width. If your cart (specifically the panels) are 2.00m wide, make consider using a track distance no less than 1.0m.
- Maximum length and all attached accessories of the vehicle Is 4.00m (13.1 ft).
    - Similarly the wheel base should be no less than 50% of the maximum length.
- The go-kart must have a minimum weight of 200kg (440lbs) without the driver, and the weight should be evenly distributed (no more than 36% of total weight on any one wheel).

Chassis and Roll Cage

The chassis and roll cage must be constructed out of materials and using techniques appropriate for the race conditions and to protect the diver in the event of a rollover.

- The roll cage must exceed the driver's profile from all sides in the event of a rollover, and must contain at least one front-to-back structural member and as indicated (Figure 2).

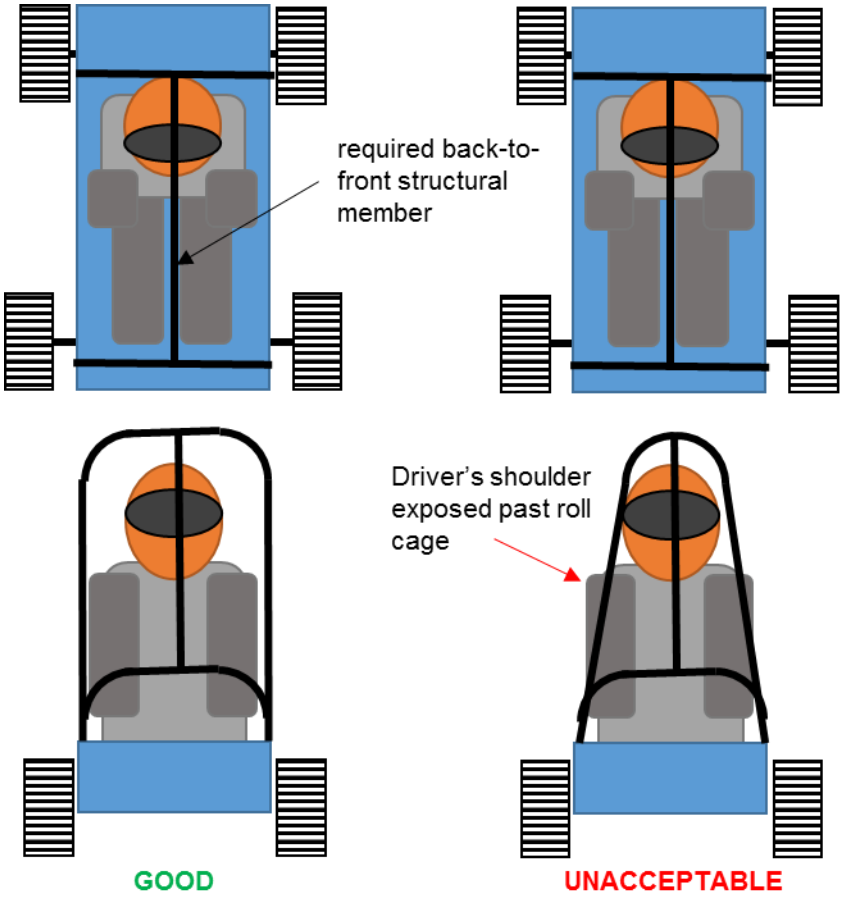

Figure 2. Top and front views showing roll cage examples.

- The chassis must have a complete and solid floor (from the seat through the front of the chassis) to prevent touching the road surface while driving.
- Side panels or bars running from the front of the chassis to behind the driver must be included with a minimum height of 0.1m (4 in) from the floor of the chassis.
- The front of the chassis must contain guards that prevent feet from protruding past the front of the chassis.
- All cart components must be rigidly secured to the cart chassis. Screws that are used to secure components should have lock-nuts, locking washers, locking pins, or thread locking adhesive. If screws on the kart come loose during the race, a kart may be disqualified until the team and demonstrate that the issues will not arise again (simply re-tightening the screw is generally not sufficient).

Tires and Brakes

- Tires must pneumatic and made from a rubber-like compound with grip suitable for pavement. No hard plastic tires.
- The primary braking system must have brakes on both of the 2 front wheels and must be operated by a foot control.
- A break light must be mounted near the center of the back of the kart. The light must be activated by the foot control for the primary breaking system.
- There must an emergency brake that will remain engaged without input from the driver.
- No brake systems should come in contact with the kart's tires.
- There must be a redundant braking system, so that if the primary braking system fails, the other can be used. Example configurations include: 1) a hydraulic foot brake on the front wheels and a hand operated cable brake on the rear axle, 2) a foot brake connected to 2 master cylinders.
- Brakes must be sufficiently strong to either lock the wheels or prevent the kart from being pushed by a single race official.

Drivetrain and Controls

- The drivetrain must consist of an electric motor and a variable speed motor controller, subject to the electrical system requirements in the following section.
- The speed input of the motor controller must be controlled by a foot pedal.
    - Note that most motor controllers have programmable power curves.
- No transmissions are allowed. The gear ratio (between the motor and the drive shaft) must be constant.

Electrical System

Please use appropriate safety precautions when working on the electrical system of your go-kart. The following are the minimum safety requirements of your electrical system. We cannot anticipate all voltage and current configurations, so please consult the National Electrical Code and equipment supplier data sheets for safety information.

- There must be a fuse or circuit breaker between the battery and the power circuitry (motor and motor controller). The fuse must be sized appropriate for your electronics and wire size. The fuse rating required for 4 AWG wiring must be no greater than 250 Amps. If you use a fuse with a higher amperage rating, your wire size must be changed accordingly.
- All wiring from your battery through the power circuitry must be 4 AWG or larger diameter.
    - Wire gauge sizes run opposite of diameter, so 3 AWG would be OK, while 5 AWG is not.
- All electrical connections must be secure and use appropriately fit electrical connectors.
- All wire and connections must be appropriately isolated from the rest of Kart and the Driver.
- There must be an emergency isolation switch (safety disconnect switch) between the battery and the power circuitry. The isolation switch must be highly visible and easily accessible to the driver while operating the vehicle. The isolation switch must meet the specifications of your current and voltage configuration.
- Power circuitry nominal voltage must fall between 12V and 48V.
- Supercapacitors or other auxiliary capacity devices are not allowed.
- The solar panels must be connected to the batteries through a charge controller.
- At least 200W of solar cells/panels must be installed.

Battery and Solar Panel Specifications

The rules below refer to the performance specifications of the solar panels and the batteries. These limits are set to provide a fair competition. Exceeding the limits below will result in race penalties and may result in race disqualification.

- The total **STC** rated solar panel capacity (peak power) must not exceed **1050W**.
    - Note that NMOT ratings are not to be used in determining system power.
- Batteries must be sealed by the manufacture (no open cells, no custom battery packs), and must be mechanically secured to the vehicle to avoid movement while the go-kart is in operation.
- The total battery storage capacity must not exceed **720 Watt-hours (Wh)**. Many batteries list their capacity in Amp-hours (Ah) for a given voltage. To calculate Wh, multiply the Ah by the nominal battery voltage. For example: a 24V, 15Ah battery has 360Wh of storage.
    - The rated Amp-hour capacity for the battery should be based on a standard 20-hour or 10-hour discharge.
    - **Lithium Batteries**! This is the first year we are allowing non-lead acid batteries, as new LiFePO4 batteries are now often cheaper than lead-acid per Wh.
      IF YOU'RE PLANNING ON USING NON-LEAD ACID BATTERIES
      The nominal voltage is often higher than the rated voltage (a "12V" battery, might actually be 13V). You **must** use the nominal voltage when calculating capacity.
- Your charge controller and motor controller must be rated for operation with the selected type, voltage, and power of your batteries and solar panels.

Auxiliary Instrumentation and Safety Equipment:

Karts may have auxiliary systems with additional independent power sources. These systems must remain isolated from the main power system of the kart. Additionally the maximum nominal voltage of any auxiliary systems cannot exceed 12V. Examples of auxiliary systems can include:

- Safety Equipment: Horn & Break Light.
- Instrumentation to measure and display speed, battery capacity, current, etc.

DRIVER SAFETY REQUIREMENTS

- All drivers must:
    - be at least 15 years of age.
    - be able to operate all controls of the vehicle, including the safety disconnect switch.
    - wear closed toed shoes while in the go-kart. No flip flops!
    - wear a long sleeve shirt and sturdy full-length pants while in the go-kart.
    - wear a DOT approved, full face helmet while in the go-kart.
    - wear sturdy gloves while in the go-kart.
    - wear eye protection (glasses/googles or the helmet visor) while in the go-kart.
    - must be able to safely exit the kart in less than 15 seconds without assistance.

Note: Team advisors & drivers hold responsibility for insuring that all drivers operate the go-kart in a safe manner, and are familiar with all safety procedures.

EVENT FORMAT AND RULES

Race Format

The event format is subject to change pending weather or other circumstances. The detailed race event schedule will be provided prior to the event.

- The race loop at FGCU is approximately 3km (1.88 miles) on a paved surface.
- The race will consist of 3 sequential 2 lap timed sprints races. There will be a staggered start to avoid go-kart congestion. All teams will be timed from the moment they are released to start until they finish. There is a 15-minute time limit for each of the 3 sprints (7.5 min per lap).
- Following the spring race there will be an endurance race lasting up to 30min. Teams will get points for each lap completed within 30minutes of their starting time, but must maintain a lap time of less than 10minutes.
- Driver must change between each sprint and the endurance race, and teams are strongly encouraged to use 4 different drivers.
- The position of the kart must be tracked via GPS (a cell phone with location sharing is appropriate) during each race. Teams should either provide kart location data directly to race officials or provide Kart location to officials promptly upon request.
- Drivers should have a means of hands-free communication with their pit team. Cell phones are permissible, a member of the pit crew should be in contact with the driver at all times. Teams should confirm audio clarity, comfort, and minimal obstruction to drivers' ability to hear other sounds & persons not using the communication system (should not be noise-canceling).

Race Rules

Event specific rules, such as starting and pit procedures as well as guidelines for penalties will be provided and reviewed prior to the race.

- Go-karts must pass a technical inspection at least 1 hour prior to the race.
- A battery specification sheet must be provided to the technical inspector that matches the labeling on the batteries.
- Decisions regarding roadworthiness of vehicles will be made at the sole discretion of the FGCU Safety Inspection Team. Decisions can be made at any point prior to the start of each race.
- The minimum sprint time is 6 minutes. This corresponds to an average speed of 60 km/hour (37mph) which exceeds the 35 mph legal speed limit.
- Go-karts must start on their own power. No push starts.
- No external charging of the batteries is allowed between sprints. Charging via solar panels mounted on the vehicle only!
- It is not permitted to block passing go-karts. Please drive on the right side (middle lane) of the street lane so that go-karts may pass on the left (when 2 lanes are available).
- Please courteously follow all instructions provided by the race officials and police. Keep in mind that race officials are volunteers there to facilitate the race for everyone.

Teams that do not adhere to race rules, do not pass the technical inspection, or fail to follow instructions from race officials will be disqualified from the race. The decision of the FGCU Safety Inspection Team is final and may not be appealed on race day.

TECHNICAL INSPECTION FORM

The team is responsible for making sure that their Kart complies with all items in this rule book. In addition to the checklist below, the kart must meet all of the rules and guidelines present in this rulebook. A FGCU tech inspector will provide a racing plate number upon approval.

GO-KART NUMBER (assigned by tech inspector):		
SCHOOL NAME:		
PRIMARY TEAM CONTACT:		
DRIVERS:	**(Pass / Fail)**	**COMMENTS:**
Full face helmet & eye protection. (Must be labeled D.O.T. approved)		
Gloves, closed-toe shoes, long-sleeved shirt and study pants (jeans or similar)		
All drivers at least 15 years old.		
Drivers are able to safely exit the kart in <15 sec without assistance.		
KART:		
5-point safety harness.		
Breaking system including: secondary brake and brake light.		
Roll-cage & chassis: all components are securely attached.		
Solar panel combined rating between: 200 and 1050W		
High current disconnect switch (visible and readily accessible)		
Batteries less than 720 watt-hours, are secured, and meeting charger rating		
Minimum 4-gauge wire for all battery / motor connections. No wires / connectors are loose.		
Mirror and horn		
Kart weight >200 kg (440lbs) & weight is evenly distributed		*FR: FL: BR: BL: Total:*
Kart is mechanically sound (no loose wires, missing bolts/parts)		
Kart GPS tracking & communication system / plans for the race.		

FGCU Tech Inspector: _____