Spring 2019 Competition

DRAFT

Rules and Regulations

Florida Gulf Coast University

Whitaker Center for STEM Education
U.A. Whitaker College of Engineering
Emergent Technologies Institute

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WELCOME

Thank you for your interest in the FGCU SunChase! 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 make the 2019 SunChase Race the best yet!

This booklet provides the 2019 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 –

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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. We recommend the starting chassis found in the “Recommended Parts and Vendors” section, because it comes with many of the required features. 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 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.

GO-KART DIMENSIONS AND WEIGHT

- Minimum track (center to center distance between the tires, Figure 1) is 32in (81cm).

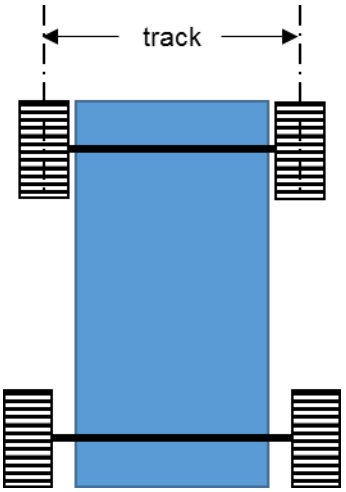

Figure 1. Top-view of go-kart showing track measurement.

- Maximum width of the vehicle and all attached accessories at any point is 6ft (1.8m).
- Maximum length and all attached accessories of the vehicle Is 12ft (3.7m).
- The go-kart must have a minimum weight of 460lbs (213kg) without the driver.

GO-KART 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).

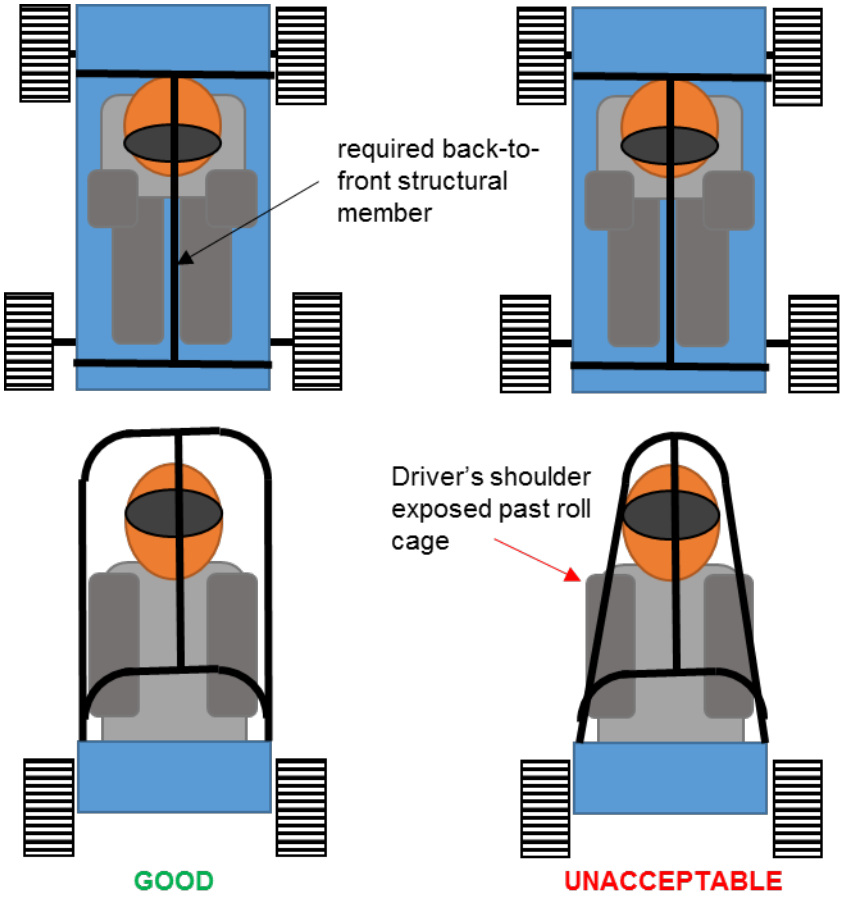

Figure 2. Top and front views showing roll cage examples.

- 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 4in (10cm) 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.

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 (as provided in the recommended kit), 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.
- 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.
- Batteries must be sealed lead-acid type only, and must be mechanically secured to the vehicle to avoid movement while the go-kart is in operation.
- 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.

BATTERIES 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 rated solar panel capacity (peak power) must not exceed **900W**.
- The total battery storage capacity must not exceed **960 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.
    - **Note**: We plan on decreasing the battery storage allowing starting in 2020 race. Teams may want to consider this in selecting components for their karts.

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.
- All drivers must be able to operate all controls of the vehicle, including the safety disconnect switch.
- All drivers must wear closed toed shoes while in the go-kart. No flip flops!
- All drivers must wear a long sleeve shirt and sturdy full length pants while in the go-kart.
- All drivers must wear a DOT approved, full face helmet while in the go-kart.
- All drivers must wear sturdy gloves while in the go-kart.
- All drivers must wear eye protection (glasses/googles or the helmet visor) while in the go-kart. Note – if the visor is opened, the driver must be wearing glasses or goggles.

Note: Team advisors hold responsibility, not the SunChase team, for insuring that all drivers are capable of operating the go-kart in a safe manner.

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 1.88 miles (3km) on a paved surface.
- The race will consist of 4 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 4 sprints.
- Driver must change between each sprint, and teams are strongly encouraged to use 4 different drivers.

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 road-worthiness 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 lap time is set to 3 minutes and 15 seconds. This corresponds to an average speed of the 35mph (which is the 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.
- Please follow all instructions provided for the pit area for the relay race, as speed violations will be enforced.

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

RECOMMENDED PARTS AND VENDORS

You may use any chassis and parts that meet the requirements in this rulebook. The following are suggested parts and vendors, with listed pricing (as of 10/2016). Be sure to ask for educational discounts!

Component	Brand / Model	Example Vendor(s) / Part number	Appx. Price
Go-Kart Kit	Roteka GK-17K-110 http://www.roketa.com/product/product_detail.jsp?cateID=259&sonCateID=0&proID=2726 Alternate: (unclear how similar to the above) Scorpion KT110 ATV	GoKartsUSA.com http://www.gokartsusa.com/browseproducts/Roketa-GK-17-(KTX-110)-Kids-Dune-Buggy.HTML http://www.motobuys.com/kt-110-kids-go-kart.htm l	$1,399 plus freight $1,149 with free shipping
Electric Motor	Motenergy ME0909 http://www.motenergy.com/me0909.html Mars 0909 24-72 VDC Brushed DC	The Robot Marketplace EMC-ME0909 http://www.robotmarketplace.com/products/EMC-ME0909.html Cloud EV 0909 Mars 24-72 VDC PM DC Motor http://www.cloudelectric.com/product-p/kelly-mars-0909.htm	$499 $479
Motor Mount	Etek motor mount DCW-ETEK50	The Robot Marketplace DCW-ETEK50 http://www.robotmarketplace.com/products/DCW-ETEK50.html	$55
Motor Controller	Alltrax AXE 4834 24-48V 300A http://www.alltraxinc.com/Products_AXE.html Kelly KDZ48300 24-48 Volt 300 Amp PM & Series	Electricmotorsport.com http://www.electricmotorsport.com/alltrax-axe4834-24-48v-300a.html Cloud EV Kelly KDZ48300 http://www.cloudelectric.com/product-p/co-kdz48300.htm	$325 $199
Electric Motor Accessories	Throttle Pot Box: EZ-Go Pot Box (0-5kOhm) Emergency Disconnect: ED250 Emergency Disconnect Switch Fuse: ANN . CNN 250A Fuse	Electricmotorsport.com http://www.electricmotorsport.com/ez-go-pot-box.html http://www.electricmotorsport.com/ev-parts/contactors-relays/emergency-disconnect/albright-ed250-style-emergency-disconnect-switch.html http://www.electricmotorsport.com/ev-parts/fuses-holders/anl-style-	$95 $35 $10

	Fuse Holder: Deltec Heavy Duty ANN / ANL Fuse Holder Pre-charge Resistor (for solenoid contactor or disconnect switch): 10W Pre-Charge resistor 48V	fuses/ann250-cnn250-very-fast-acting-limiter-fuse-250-amp.html http://www.electricmotorsport.com/ev-parts/fuses-holders/fuse-holders/deltec-heavy-duty-anl-fuse-holder.html http://www.electricmotorsport.com/ev-parts/contactors-relays/parts-accessories/wirewound-pre-charge-resistor-10w-470-ohms.html	$21 $10
Batteries	Sealed Lead Acid: 12V 20Ah (x4)	Various Vendors	~$40ea.
Wire	4 Gauge battery cable recommended	Various Vendors	
Maximum Power-Point DC-DC Controller (Solar panel battery charger)	Blue Sky Energy Solar Boost 3024iL http://www.blueskyenergyinc.com/products/details/solar_boost_3024il	altE store https://www.altestore.com/store/charge-controllers/solar-charge-controllers/mppt-solar-charge-controllers/blue-sky-solar-charge-controllers-mppt/solar-boost-3024il-solar-charge-controller-no-display-p6784/?gclid=Cj0KEQjwmri_BRCZpaHkuIH75_IBEiQAIG0rIbqw5MpwShEHXgdgHawDUJA_QWGI5vjFlSUkApDiBFMaAl5q8P8HAQ	$273
Solar Panels	Maximum of 810W Recommend 3x 270W Panels	Various Vendors We have a limited number of older panels at FGCU that we will lend out.	$260-280 Each $239 Each

TECHNICAL INSPECTION FORM

The team is responsible for making sure that their Kart is in compliance 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:	**FGCU TECH INSPECTION**	**COMMENTS:**
Full face helmet (Must be labeled D.O.T. approved)		
Eye Protection (visor or goggles)		
Gloves, closed-toe shoes, long-sleeved shirt and study pants (jeans or similar)		
Drivers at least 15 years old		
KART:		
5-point safety harness		
Breaking system, including secondary brake		
Roll-cage		
Solar panel maximum combined rating of 810W		
High current disconnect switch (visible and readily accessible)		
Batteries are secured		
Battery max 960 watt-hours		
Minimum 4 gauge high-current circuit wire		
Mirror and horn		
Kart weight >460lbs (209kg)		
Kart is mechanically sound (no loose wires, missing bolts/parts)		

FGCU Tech Inspector: _____