SARSEF

Racing the Sun

2022-2023 Competition Rules

Introduction

Racing the Sun (RTS), is a Solar kart competition organized and hosted by SARSEF. The program seeks to foster and promote interest and workforce skill development in STEM (Science, Technology, Engineering, and Mathematics) among high school students.

Karts are designed, built, and tested by high school students. The competition links industry and students to work collaboratively to design and test basic engineering and science concepts. Throughout the program students develop workforce and entrepreneurial skills. They learn application of engineering concepts in the real world, they use math to solve problems, and they experience first-hand how solar energy and other forms of electricity can be used.

Many of the ideas and rules listed here have been adopted and revised from the American Solar Challenge. The rules and regulations set out in this document are the guidelines for this program. The rules are subject to change at the organizers discretion in the case that errors or omissions are discovered, or in the case that mentors or technical advisors come to a consensus that a rule change is necessary.

Mission Statement

Racing the Sun's mission is to provide a fun and safe STEM experience for students with active and innovative minds. The competition strengthens exploratory skills, entrepreneurship skills and provides real world experiences. Solar technology is the organizing concept used in developing critical thinking and learning skills that correlate between academics, industry and workforce.

General Guidelines

1.1 Team Definition

RTS is a team based educational initiative to design, develop and promote STEM skills in high school students (grades 9-12). In order to participate in the RTS competition a team shall consist of at least one Academic Teacher (although two teachers are highly recommended), and a minimum of 5 (recommend 10-15) student competitors.

1.1.1 Academic Teachers

Teams are encouraged to have two academic teachers. The lead academic teacher serves as the Project Lead. It is suggested that the Project Lead be a subject matter expert in technical fields such as engineering, electrical or electrical systems, mechanics or mechanical systems, construction, fabrication or automotive skills, for example. The lead teacher provides technical guidance and advice to students without actually working on the vehicle.

A second academic teacher is highly recommended to provide complementary assistance to the students and support them throughout the program. The second teacher may act as the Project Lead in the absence of the mandatory academic teacher.

Teachers must be present while students work on their karts and participate in events to mandate safe practices and safe kart operation at all times including on Test Day and Race Day.

1.1.2 Community Teams

Teams of high school students with a designated adult ‘teacher’, not affiliated with any high school, shall be able to submit applications to compete in the Racing the Sun Program with the same rules, requirements, and expectations as a regular team.

1.2 Mentors

Mentors supplement the competition, provide guidance and help students acquire and understand the necessary technical knowledge needed for the solar competition. They support the classroom teachers and RTS staff. RTS mentors have a wide background of experience. Our mentors have included an engineer who was part of a team that set a land speed record, a former crew member for a dragster team, a mechanical engineer who likes to build engines, solar industry professionals and physics experts to name a few.

1.3 SARSEF

The competition is organized by SARSEF. SARSEF creates the place, environment and interactive ground that generates, attracts and retains technology companies and talent in alignment with the research, mission and goals of the University of Arizona and SARSEF. SARSEF is a 501(c)(3). Our mission is creating Arizona's future critical thinkers and problem solvers through science and engineering. For more information about SARSEF, please visit www.sarsef.org.

1.4 Organizers

From this point forward in the rulebook, the collective governing body formed by the judges, mentors, competition organizers, track officials, and any other group approved by SARSEF to make decisions on their behalf shall be referred to as the Organizers.

1.5 Entry Registration

1.5.1 Registration

Each team participating in RTS must submit the following forms:

Form	**Due Date**
Team Application	October 3, 2022
Team Roster	October 20, 2022
Waivers	October 20, 2022

1. Team Application

   This is a commitment by the school and teacher to participate in the full Racing the Sun Season, culminating in Race Day, April 29, 2023.

2. Team Roster

   Team rosters shall be submitted digitally via the link provided during Team Registration. Rosters shall be submitted by October 20, 2022.

3. Waivers

   Each listed person on the roster and anyone planning to attend in person Racing the Sun events as a part of the team must submit a digital copy of the waiver. Waivers must be completed digitally via the link provided during team registration.

   1. Waiver forms from Musselman-Honda Circuit* (available during in person events at race track)

   *Should the Racing the Sun program expand beyond the Tucson events, any track at which an event is hosted may require their own waivers.

All waivers must be submitted by the final due date. We are not able to accept late waivers, due to the complexity and number of students participating in the competition. Any student who attends in person Racing the Sun events such as Test Day or Race Day and does not have completed waivers on file in advance shall be required to wear a colored wristband and sit in the grandstands. Without prior approved waivers, students are prohibited from working with their team or entering the pits or any other restricted area of Musselman-Honda Circuit. NO WAIVERS SHALL BE ACCEPTED ON TEST DAY OR RACE DAY.

Completed waivers may be submitted digitally. Contact America Miranda (america@sarsef.org) for assistance.

1.6 Cost of Competition

The competition cost is based on the overall cost of the competition divided across the teams participating. Each team shall receive one invoice with all fees included. It is incumbent on the teacher to work with their school and school district to follow policies for purchase and payment. All fees shall be received by SARSEF by January, 2023.. All fees are non-refundable.

For teams competing in the standard class of the 2022-2023 season, entries can be purchased for $3150. Entries for teams competing in the maker or legacy class can be purchased for $1700.

Racing the Sun competition fees include costs for workshops, events, track rental, room rentals, signage, marketing materials, legal fees and kart kit components.

Standard Kit Components included with the team registration fee:

400W Flexible Solar Panel 2x200 Watt Solar Panel High-Efficiency Monocrystalline Solar Panel

Renogy Boost 10A 36V/48V Auto DC Input MPPT Solar Charge Controller

50 Watt 12 Volt Monocrystalline Solar Panel

Motor & Controller

12v DC 4 Ah SLA Battery (1)

12v 10 Ah SLA Battery (3 pack)

Front Tires (145/70-6) 2 TIRES

Back Tires (20x7-8) 2 TIRES

Legacy Division Components included with team registration fee:

Renogy Boost 10A 36V/48V Auto DC Input MPPT Solar Charge Controller

50 Watt 12 Volt Monocrystalline Solar Panel

12v DC 4 Ah SLA Battery (1)

12v 10 Ah SLA Battery (4 pack)

Front Tires (145/70-6) 2 TIRES

Back Tires (20x7-8) 2 TIRES

Maker Kart Components included with team registration fee:

800 Watt Solar Panel Kit

Renogy 40A 12V/24V Auto MPPT Solar Charge Controller

24V 500W Brushed Speed Motor and Controller

NP12-7Ah F2 12V 7Ah AGM Rechargeable Maintenance Free Valve Regulated Sealed Lead Acid Battery with F2 Terminal

1.7 Competition Schedule 2022-2023

All teams shall be provided access to the necessary registration materials as listed in section 1.4 and the event schedule (see Appendix II Schedule and Points).

Contact America Miranda, Program Director, for all necessary information America@sarsef.org.
Late penalties and registration: A late fee of $200 will be imposed for any registration paperwork submitted more than 5 days late or after October 20, 2022. Teams that have not submitted all paperwork by October 20, 2022 may be ineligible to participate.

1.8 Events

All teams shall review the schedule of dates (see Appendix II Schedule and Total Points System) and RSVP the number of participants (students and teachers) for each event no later than 2 weeks prior to the event date. Most events include points for participation and it is the responsibility of each team to know how many points are associated with each event. Failure to RSVP 2 weeks in advance may result in a team not being able to participate in an event.

Progress Check: The 2022-2023 progress check shall be scored based upon completion of specific components of the kart. The fabrication of the chassis shall be completed to include a belly pan, front and rear axles, steering, wheels and tires, roll bar and roll cage. A 175 lb static load test will be conducted to gauge the structural stability of the kart at the progress check.

Test Day: Test day will take place April 1, 2023, teams shall participate in checkpoints and their average of 3 lap times shall determine their qualifying position for Race Day.

In case of inclement weather on Race Day or Test Day, the organizers reserve the right to cancel these events and reschedule them for the following Friday or Saturday. Notice of any cancelation will be provided via phone message or email 24 hours in advance should this situation arise.

1.9 Fundraising and Sponsorships

Fundraising is vital to the RTS competition. Through fundraising activities students learn and practice organizational, management and entrepreneurial skills. Fundraising helps students network with professionals from different industries and promote Racing the Sun to those outside the program. Students learn the concept of goal-setting and working towards that goal. They improve their communication skills and practice their math and financial skills. Fundraising for RTS gives them an opportunity to present their ideas and articulate a pitch to donors.

Students are expected to participate in fundraising or seek sponsors in order to alleviate the cost of the program. Teams shall raise funds to cover the budget presented in their project plan and their registration fee. Teams are expected to document and discuss their fundraising challenges and successes in their verbal presentations. Fundraising and sponsorship can include donated materials, cash or other contributions made in support of a team.

Fundraising and sponsorship shall include but not be limited to donated materials, cash or other contributions made in support of a team. Volunteer time shall be considered a donation and shall be valued at $15.00 per hour of volunteer time. Teams are allowed to raise up-to $2000 in add-on materials for their kart. Components purchased by SARSEF shall not be replaced or upgraded.

Race Profile

2.1 Race Classes

There are three classes of kart eligible for competition in the Racing the Sun season.

2.1.1 Standard Class

Teams may purchase a standard chassis for building the kart. The only modifications allowed to this chassis are the addition of a solar panel and the addition of the electrical components provided by the organizers. Teams participating for the first time are highly encouraged to compete in this class. Any vehicle deemed non-compliant to the build specifications for this class shall be penalized or disqualified at the discretion of the Organizers. Any other modification, especially for safety or ergonomic concerns, may be allowed or disallowed at the discretion of the Organizers. No modification may be made for performance reasons outside of the modifications listed above.

2.1.2 Legacy Class

Teams may compete in this class with a modified or unmodified version of the standard chassis provided previous to the 2021-22 season. This class shall be held to the same electrical and safety regulations as the other classes. Legacy class shall have the opportunity to use solar panels from previous years to charge batteries. The Organizers may also require safety modifications at their own discretion, or disallow a kart from competing for safety reasons in extreme cases.

2.1.3 Maker Class

Teams must design and build a kart in accordance with the specifications described in section 3. Any vehicle deemed non-compliant to the build specifications for this class will be penalized or disqualified at the discretion of the Organizers. The Organizers may also require safety modifications at their own discretion, or disallow a kart from competing for safety reasons in extreme cases.

2.2 Race Competition

Karts shall compete within their own class and not against other classes. Test Day or Race Day may include a trouble shooting challenge in addition to the qualifiers, race and inspections. Teams shall be updated of any schedule or itinerary changes as they are planned.

2.2.1 Rescheduling of Race Day

In case of inclement weather, test or race day may be rescheduled (see 1.8 Events).

2.2.2 Race Day Timeliness

Teams may arrive at the track no sooner than 20 minutes prior to registration. Late teams may be penalized in points. Exceptions may be made for justified extenuating circumstances at the sole discretion of the organizers.

2.2.3 Race Format and Winning Categories

1. Grand Champion

   The team that accrues the most points through the season, including Race Day.

2. Innovator Award

   The team that designs the kart deemed by a majority of scrutinizers (by vote) to be the best in terms of functionality, design ideas, safety, or aesthetics, as examples. Innovations must be demonstrated and identified by the team in the final drawing submittals, progress checks, verbal presentations, and on Test Day and Race Day.

3. Speed Award

   The kart having the fastest 3 lap average in each class. The 3 lap average is the average of the 3 fastest lap times.

4. Endurance Award

   The team having the highest number of laps in their class.

5. Best Verbal Presentation

   This award will be given to the team who is awarded the most points by the judges during their verbal presentation.

6. Spirit Award

   This award will be given to the team judged by the Organizers to have the best competitive spirit through the season and/or being the most willing to help others.

7. Best Appearing Team and Kart

   To the team with the best appearing kart and crew

8. Efficiency Award

   To the team having the lowest deviation weighted on the number of laps in their class. It is based upon how well the kart uses the energy provided, either through batteries alone (standard and legacy class) or through solar panels only (maker class) by the time recorded for each lap and the number of laps.

2.2.4 The Track

The race will take place at the Musselman Honda Circuit located at 11800 S Harrison Road in Tucson, AZ. The length of the track used for RTS competition is estimated at 1,584 feet or 0.3 miles. Race Day organizers or Musselman Honda may change track length at their discretion. Teams will be informed of track length changes within 48 hours. No tents or shade structures of any kind are allowed at the track with the exception of those put in place by Musselman Honda or Race Day organizers.

Should the RTS program expand elsewhere in Arizona, additional tracks may be available for competition. Teams shall be kept assessed on competition details.

Mechanical Specifications

3.1 Chassis

Three different classes of chassis are permitted. All kart designs are subject to mentor and race organizer review and approval. Mentors and organizers will approve or deny designs based on drawings submitted and physical inspections of the karts with safety being the highest priority in this competition. The roll cage shall not be modified for Standard or Legacy karts.

3.1.1 Standard Class

Race organizers will order the standard chassis for the teams once all registration paperwork is submitted and a PO from the school has been received. All teams participating for the first time are highly encouraged to compete in the standard class. The team will retain ownership of the kart at the end of the competition, assuming they complete the competition and have paid all invoices. Teams shall not alter the structural metal frame. If a team is disqualified or drops out of the competition prior to paying the invoice for fees due, any chassis or parts provided must be returned damage free to race organizers. All karts must be reviewed and approved by mentors/technical advisors, and the competition organizers prior to the team building the kart; and are subject to penalty or disqualification if the design or construction of the kart is deemed unsafe.

3.1.2 Legacy Class

Teams may enter the Legacy Class with the chassis considered a Standard kart previous to the 2022--23 season. The chassis itself shall not be modified. Any other change will be permitted at the discretion of the Organizers so long as the kart uses the mandated electrical components and adheres to all safety regulations. All karts shall be reviewed and approved by mentors/technical advisors, and the competition organizers prior to the team building the kart; and are subject to penalty or disqualification if the design or construction of the kart is deemed unsafe.

3.1.3 Maker Class

A chassis shall be built to the requirements specified in Sections 3 and 4, Mechanical Specifications and Safety Regulations respectively.
Teams shall build a kart from scratch with their own materials, however, all current year requirements must be followed. Specified parts mandated by the organizers shall be used. These parts are detailed in section 3.2. The team will retain ownership of the kart and all components at the end of the competition. All karts shall be reviewed and approved by mentors/technical advisors, and the competition organizers prior to the team building the kart; and are subject to penalty or disqualification if the design or construction of the kart is deemed unsafe.

3.2 Vehicle Design and Construction

All karts are subject to mentor and race organizer review. The major components of the kart (structure, body, battery compartment, motor mount, drive system, electrical system, suspension, running gear, etc.) must be exclusively designed and constructed by the students, if competing in the maker class. The standard and legacy karts obviously require less design, but the Organizers recommend all teams read this section. Adherence to these regulations is required in all classes. It is highly recommended that even experienced teams read the SARSEF Technical Handbook. This Handbook will be sent to participating teachers at the beginning of the competition and will be available on the Racing the Sun portal of the SARSEF website.

The structural development and fabrication of the kart shall follow the regulations listed below.

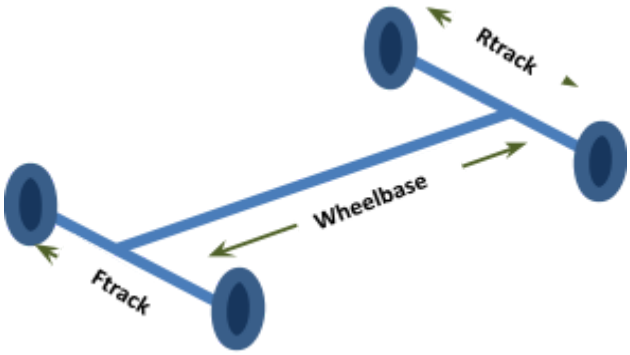
3.2.1 Structure

Safety is the primary concern in the construction and competition of each kart. Insufficient regard for structural safety will result in disqualification from the event during scrutinizing on Test Day or Race Day. The Structural Rigidity section of the Technical Handbook will contain more in-depth advice for teams creating their own kart.

3.2.2 Physical Dimensions

Teams shall not modify the size of the Standard Novice Class nor the Legacy Class chassis'.

For Maker Class karts the wheel base shall be at least within one foot, either side of the solar panel dimension. Deviations to this requirement may be submitted with Weight, C.G. and Tipping Force calculations to prove stability of the kart expected during Test or Race day.



The wheelbase shall be measured between the rotational center of the wheels.

3.2.3 Wheel Requirements

1. The kart shall use four wheels, which shall be in contact with the ground at all times to provide stability.

2. Front wheels and rear wheels shall be arranged such that they are symmetrical around the vehicle centerline with respect to its left and right sides.

3.2.4 Dynamic Load Test

As of 2022-23, all karts shall pass a 175 lb. dynamic load test. With 175 lbs. weight placed in the seat of the vehicle the kart shall be able to hold and function wheels, steering and brakes without signs of failure. This load test will be performed at the progress check, on test day and on race day.

3.2.5 Roll Cage

The next section deals with the safety of the driver and will address the allowed method of providing safety to the driver in the event of a collision or roll-over. This is for Maker Class karts. Standard Class and Legacy Class karts already have a roll cage and shall not be modified.

A Roll “CAGE” differs from a Roll “BAR” in that a Roll Cage will include some form of overhead tubing structure that extends forward on both sides from the main hoop along the roof line to the area in front of the driver, across the roof and line and down to the frame of the kart. A roll bar does not necessarily provide side-impact protection.

A roll cage provides protection surrounding the driver in case of a collision or roll over. All karts shall have a roll cage that provides rigid protection encompassing the entire driver in the event of a collision and meeting the following requirements:

1 It is integrally fixed to the chassis in such a fashion that it encompasses the entire driver in the event of a collision. It allows free motion of the driver’s head and body in all directions.
2 There shall be at least 2” of clearance in all directions between the roll cage and the driver’s helmet, with the driver seated in an upright position. Upright position is defined as the driver seated in the normal operating position of the kart.
3 Teams shall demonstrate roll cage compliance on Test day and Race Day.
4 The mechanical drawings should include the dimensions of the roll cage to illustrate how it protects the driver in case of a collision.
5 See samples for guidance, Appendix X.

If a roll cage does not meet the expectations of the organizers, mentors, judges, or track officials, a team shall be required to redesign or otherwise modify their roll cage, at the above parties’ sole discretion. A team shall be excluded from participating in any test or race event if their roll cage is judged insufficient or illegal.

Alternate constructions may be considered and approved at the discretion of the mentors, judges, organizers, or track officials.

3.2.6 CG Calculations - Maker Class

As the Maker Class will be carrying solar panels on the vehicle and the wheel base is selected by the designers, each Maker Class kart team shall perform weight and Center of Gravity (C.G.) calculations and provide those on Test day and Race day. The C.G. calculations shall be done for Maker Class karts as follows: Step 1. The kart's C.G. shall be determined without a driver in the kart. Step 2. The kart's C.G. shall be determined with the tallest driver in the kart. The team shall calculate the force required to tip the kart using the C.G. determined from Step 2. Tipping force is defined as the force required to make the wheels, on the side the force is applied, loose contact with the ground. The team shall determine through calculation or measurement the force required to tip the kart on its side for only the side with the lowest tipping force.

3.2.7 Ground Clearance

On test day all karts shall be tested by driving over a 3" plank. No part of the kart shall touch the plank except the wheels.

3.2.8 Kart Numbering

Each kart shall be given a number. Number placement and size is determined by track managers. School names and colors on karts are highly encouraged.

3.2.9 Weight of the Kart

A kart is weighed with all components that will be part of the kart during the race without the driver. Karts are weighed on Test Day and Race Day. Teams not meeting the minimum weight have an opportunity to add more weight to the kart to meet minimum weight requirements. Teams unable to meet the minimum requirement will not be allowed to compete.

1. Karts in the standard and legacy classes do not have to meet a minimum weight.
2. Maker karts must meet a minimum weight of 150 pounds.

3.2.10 Power

The batteries provided by the organizers are the only source of power that can be used by the kart motors. These batteries shall only be charged from the solar panels provided by the organizers.
Karts shall have two kill switches, one accessible by the driver and one accessible by track officials. The switch accessible by track officials shall be mounted on the rear of the kart but shall be protected from accidental shut off or impact.

Teams are encouraged to construct the support system for the solar panel after they receive the solar panel to insure exact dimensions. The solar module may have any placement or mounting orientation. The module must be firmly secured to the vehicle and shall not obstruct the driver's view. Any leads extending from the solar module must be secured properly to avoid any shock hazards. All components must follow the safety regulations.

3.2.11 Auxiliary Devices

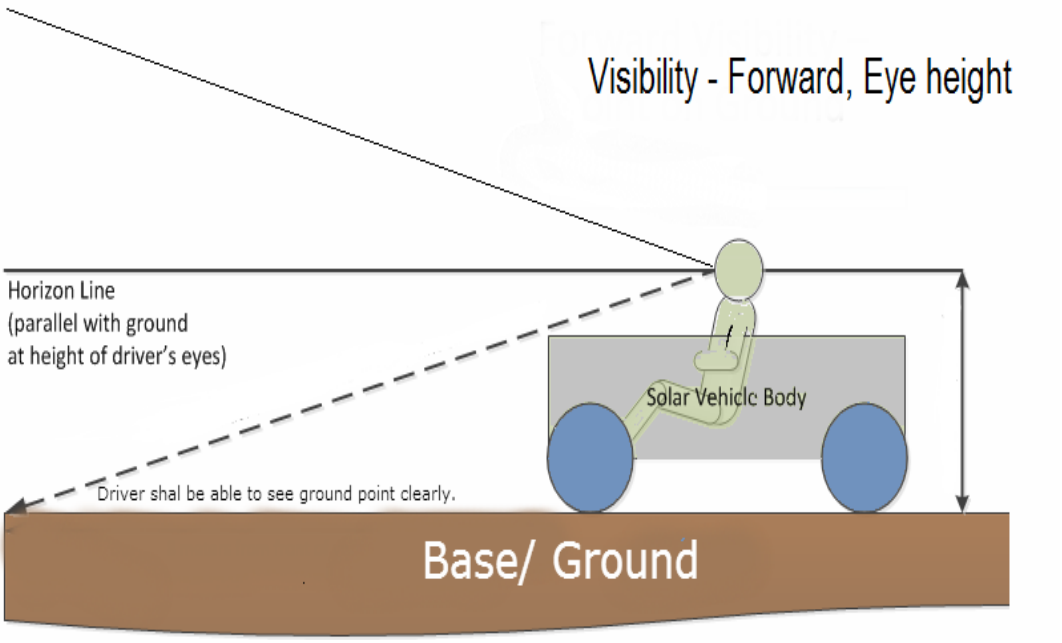
Any device used to assist the start, stop, or powering of a kart must be a permanent and affixed part of the electrical system. Once the competition begins, teams are prohibited to plug any other devices into the kart or charge their batteries by any means other than the provided solar panel. Proper attachment of auxiliary devices is the responsibility of the team. Teams shall ensure all the auxiliary devices are firmly secured and attached to the kart. "Push start" of a kart on Race Day is prohibited.

Safety Regulations

Safety is the primary concern in the construction and competition of each kart. During the safety inspections on Test Day and Race Day, karts will be required to demonstrate compliance with all safety regulations and are subject to disqualification if the organizers or technical judges determine the kart design or construction has unresolvable safety issues.

4.1 Seating Position

Proper seating of a kart driver positions the driver's head above and behind the driver's feet and facing forward. A driver's seating angle must be no lower than a 45 degree angle and no higher than a 90 degree angle. In the normal driving position, each driver's eyes must be a minimum of 27" above the ground. Use the below diagram as a general guide. If a driver's seating position is judged to be a safety issue by the organizers or mentors, the team is responsible to redesign this part of the kart before competition.



4.2 Visibility

All kart drivers shall be able to see with minimal obstructions. Drivers shall have clear visibility of traffic to the front, left, right, and back. All karts shall include a rear-view mirror attached to the frame, clearly visible by the driver and positioned in such a way that the driver can see traffic behind.

4.3 Bumpers

Any horizontal-facing structural component outside the trapezoid formed by the four contact patches, extended vertically, shall be covered by a rubber or foam bumper. For instance, a kart whose solar panel support panel extends outside the trapezoid described above must provide a bumper around the edges of the panel. In addition, at the discretion of the Organizers, a similar bumper may be required for any unfinished edge of any car component for the safety of the driver or team as noted in 4.15.

4.4 Belly Pan

A belly pan is a sheet of metal that covers and protects the underside of an automobile. The cockpit must be equipped with a full belly pan to isolate the driver from the road and provide protection in the case of a seat malfunction. The driver's feet shall not be able to touch the ground while seated in the kart. A driver shall not be able to extend a leg or foot in any direction and touch their foot to the ground while driving or in a seated position. The driver shall be asked at any time, by judges, organizers, mentors, or track officials, to demonstrate a reasonable attempt to touch the ground while correctly seated in the kart.

4.5 Covers and Shields

All revolving and moving parts of the kart (especially parts that are within reach of the driver) shall be covered to prevent accidental contact. This includes the front/rear wheels and any moving parts. Only operating controls shall be accessible to the driver. The purpose is to prevent fingers, hair, clothing, jewelry and similar objects from getting caught in the revolving parts and causing an injury. The kart's compliance to this requirement will be verified on test day or race day, and the Organizers shall ask the driver at any time to demonstrate a reasonable attempt to touch any part of the kart drivetrain from a correctly seated position. Teams shall be required to make any change to their powertrain covers at the discretion of the Organizers at any point. Failure to comply may result in disqualification or a team being barred from a track session.

4.6 Safety Belts

All karts shall be equipped with a four-point harness safety belt. The use of safety belts is mandatory any time a vehicle is moving. The safety belt system shall be attached to the chassis of the kart. The upper end of the shoulder belt must be connected to an appropriately rigid mounting point which is equal to or lower than the driver's shoulders.

4.7 Shock Hazards

All battery packs shall be marked with "High Voltage" warning stickers or signs. These signs are designed, manufactured, or purchased by the teams. The Organizers do not provide these as part of the standard equipment package.

4.8 Electrical Wiring

A wiring diagram shall be provided to RTS organizers per the schedule. All wiring in the vehicle must be properly insulated and secured to prevent electrical shock, accidental damage or injury. Any team with loose or hanging wiring not corrected before competition will be penalized points or disqualified at the discretion of the Organizers. Teams purchase their own wiring.

4.9 Battery Circuit Breakers

Battery fuses or circuit breakers shall be installed in all karts. Circuit breakers are tested on Test Day and Race Day and fuses shall be verified for rating. Teams must purchase their own fuses or circuit breakers.

4.10 Brakes

All karts shall be equipped with a functional and properly mounted braking system and shall be able to stop repeatedly. Operation of the primary brake system should not

result in un-commanded turning of the cart. The brakes shall be capable of preventing the kart from moving with a driver seated and applying brake pressure. Brakes shall be tested on Test Day and Race Day.

4.11 Battery Container/Cover

Batteries shall be secured in such a manner as to prevent the batteries from moving, dislodging or being expelled from the kart in the event of an accident by either impact or roll-over. Use of Tupperware(r) or Tupperware(r) type products to enclose the batteries shall not be used or allowed. Use of nylon straps shall not be allowed to hold batteries in place. Enclosed metal structures shall have vent holes to allow for proper venting of gasses generated during charging of batteries. If an enclosed metal structure is used the enclosure shall be designed to prevent movement or shortening of the batteries in the event of an impact or roll-over. An enclosed metal structure is defined as covering all six sides of the batteries utilizing a removable lid to allow access to the batteries. If an enclosure is not used a Protective shield or plate shall be installed to prevent direct access to the battery terminals. The protective shield or plate shall be removable to service the batteries and/or battery connections. The battery area shall be marked with HIGH VOLTAGE stickers. Any cable connector carrying battery voltage or motor voltage shall be protected by either shrink wrap, protective covers, or manufactured connector sleeves/covers to prevent accidental contact with battery voltage.

4.12 Steering

All karts shall have competent steering systems and a steering wheel. All steering mechanisms must be directly operated by the driver. Steering is tested on Test Day and Race Day to ensure compliance with competition rules. At the discretion of the Organizers, a team may be asked at any time to redesign, rebuild, or otherwise modify any part of their steering system at any time. In the event of safety concerns on the part of the Organizers, any kart may be disqualified from any test or race event.

4.14 Speed

The maximum allowable average speed for a kart is 25 mph. This is verified with transponders and/or radar gun.

4.15 Sharp Edges

Kart designs shall not include sharp edges, unfinished metal or severely pointed objects. All efforts shall be made by teams to design and fabricate rounded corners and to incorporate safety features such as rubber edging over potentially hazardous metal edges.

4.16 Kill Switch

The EMERGENCY STOP switches shall either operate directly in the battery circuit or shall deactivate a NORMALLY OPEN RELAY to interrupt battery power. The EMERGENCY STOP switches shall be rated to handle the motor battery voltage. The EMERGENCY STOP switch shall interrupt the motor battery from supplying power to the motor controller. One EMERGENCY STOP switch shall be accessible by Track Officials and shall be located in the back of the vehicle. The second EMERGENCY STOP switch shall be within easy reach of the driver. The driver shall be able to access and operate the switch without looking at the switch.

4.17 Driver Responsibility

Team members and teachers have a responsibility to read all rules and protect the safety and well-being of other competitors and spectators. Teachers must be present whenever a kart is being driven. Safety related items shall not count against the $2000 limit of allowable additions to the kart.

4.17.1 Helmets and Neck Collars

When the kart is in operation the driver shall wear a full face helmet encompassing the entire head of the driver with face and eye protection and neck collar. HELMET RATINGS: Any full face helmet showing signs of wear and tear from impact or accident shall not be allowed for use during Test Day or Race Day. Auto racing helmets are rated by the Snell Foundation as either SA, M, or K rated.Only Snell Rated SA or K ratings shall be allowed. Snell SA Rated Helmets: Snell "SA" (Sports Application) rated professional helmets are designed for auto racing and provide extreme impact resistance and higher fire protection. Snell K Rated Helmets:Snell "K" (Karting) rated helmets are designed for Karting applications. They are subjected to the same test standards as SA helmets except the do not require a fire retardant interior. New Snell ratings typically come out every 5 years. The current Snell rating is 2020. Any Snell rated helmet prior to Snell 2015 shall not be allowed. If the helmet is not Snell rated it shall not be allowed for testing or racing.

4.17.2 Eye Protection

All helmets shall include a full face mask.

4.17.3 Clothing

All team members shall wear protective gear. If any clothing worn by a team member is deemed inappropriate or unsuitable for competition, a team is subject to a point penalty or disqualification at the discretion of the Organizers. Suitable clothing includes, but is not limited to: Long pants, such as jeans, provide protection from the waist to the ankle.

Pants with holes ,spandex, lightweight fabrics, or extreme bell bottoms shall not be permitted. Long-sleeved shirt covering the entire length of the arm from shoulder to wrist shall be mandatory for the driver of the kart and is recommended for team members as well. Gloves covering the entirety of the driver's each finger, hand, and wrist shall be worn during testing or racing. Closed-toed shoes and socks that cover the entire ankle. High top shoes are recommended. Sandals, flip-flops, or any other shoe that exposes part of the foot shall not be allowed for any team member.

4.17.4 Driver Training

Every driver participates in driver training. Teams shall have a minimum of two drivers: Primary driver and back-up driver. Training entails track safety, track officials, meaning of flags, safety awareness, maneuvering techniques and etiquette.

4.17.5 Non-Permitted Driving

Drivers may drive on the race track only. The kart shall be pushed at all other times by team members while the driver is seated and in control of the kart. This includes any movement of the vehicle between check points, positioning on the track or any other situations. Teachers shall escort their team with kart at all times. If a school has more than one team, teachers shall be responsible for providing additional adults to escort those additional teams with karts.

4.17.6 Passing

Drivers pass other vehicles as directed by track officials. Failure to comply with track safety officials shall result in a point penalty or disqualification of the team.4.18 Teacher Responsibility

All teams shall be escorted by a teacher from the school. In the event a school has more than one team, the teacher shall be responsible to find an adult approved by the school to chaperone any additional teams. Teachers and approved Team adults shall be responsible to read all rules and help enforce safety requirements and track etiquette.

Team Submittals

Teams that begin construction of their kart before electrical and mechanical approvals may be required to redesign their kart based on requirements mandated by the organizers and officials. The Organizers are not responsible for any costs, fees, lost time, or materials affected by a mandated redesign. Submittals shall be uploaded to team folders by designated deadlines.

5.1 Project Plan (Drafts: 200 points each; Final: 400 points)

All teams must submit a project plan. Submission is via team folder as a PDF with a file name as follows: [School Name] Draft Project Plan or [School Name] Final Project Plan. Google Docs may not be accepted. The project plan highlights the timeline and budget of the project including:

- Project milestones and planned completion dates for each milestone
- Itemized list of materials and equipment required for building the solar kart including quantity and unit price
- Total budget for fundraising
- Description of each team member's role on the team

Project plans are created by students with guidance from the teacher. A project plan submitted more than 24 business hours past the due date is late and will not receive any points. Business hours are Monday-Friday 8am-5pm.
Teams are required to update the project plan and resubmit by the due date as specified by the organizer.. An updated project plan includes milestones with dates, required materials or parts for design and construction, and a fundraising plan identifying funding sources.

5.2 Electrical Drawing (Drafts: 200 points each; Final: 400 points)

All teams shall submit a complete schematic diagram showing the electrical layout of the kart. The electrical drawing must be submitted via team folder as a PDF with a file name as follows: [School Name] Draft Electrical or [School Name] Final Electrical. Google Docs may not be accepted

An electrical drawing submitted more than 24 business hours past the due date is late and is subject to point deductions.. Business hours are Monday-Friday 8am-5pm. Preliminary submissions will not be scored and are for review only.

An Electrical drawing includes wiring for the propulsion, solar, instrument, and battery systems. Mentors score drawings. Students with guidance from a teacher are responsible for the design of the electrical system.

5.3 Mechanical Drawing (Drafts: 200 points each; Final: 400 points)

A mechanical drawing is a detailed drawing showing the kart frame and construction and the mechanical assembly of the system. The mechanical drawing must be submitted via team folder as a PDF with a file name as follows: [School Name] Draft Mechanical or [School Name] Final Mechanical. Google Docs may not be accepted.

A Mechanical drawing submitted more than 24 business hours past the due date is late and subject ot point deductions. Business hours are Monday-Friday 8am-5pm.

Mechanical drawings include a frame structure, steering, overall dimensions, seat belt design and placement and angles in three views (front, top, and side). Mentors score drawing. Students with guidance from a teacher are responsible for the design of the mechanical system.

5.4 Data Sheets and Notebook (800 points)

Teams must electronically document the design process to include structural, mechanical and electrical designs and changes occurring during planning and fabrication. Details include: project plans, mechanical drawings, electrical drawings, and requests for variance. The notebook is a documentation of all changes and results of those changes during fabrication. A hard copy of this notebook must be presented at the progress check for a maximum of 200 points, verbal presentations for a maximum of 200 points and on test day and race day for 200 points respectively, to allow mentors to verify changes made were approved, and designs are in conformance with design proposals.

Safety General

Safety is the primary concern in construction and competition of each kart. During the safety inspections on Test Day and Race Day, karts are required to demonstrate compliance with all safety regulations and are subject to disqualification if the organizers or technical judges determine the kart design or construction to be in violation of safety requirements.

Each team is responsible for the track worthiness of their kart. All karts must be maintained in a safe, road-worthy condition at all times. Any deliberate deviation from safety regulations at any point of time during Test Day or Race Day is an automatic disqualification.

6.1 Inspection

Inspection of karts occurs on Test Day, Race Day and at other points throughout the competition. Teams are required to perform a test run, demonstrate proper ground clearance, and show compliance with safety regulations. The safety regulation tests mandate the presence of the driver, back up driver and proper safety gear (clothing, full face helmet, etc.).

Teams shall pass safety inspections in order to operate their karts on the track. Teams failing the safety inspection have the opportunity to remedy the issue under the following situations:

6.1.1 Test Day

Teams have until their scheduled track time to resolve any safety or operational issues that resulted in a failure to pass the inspection; however, teams will lose points during the day if they are unable to participate in other scheduled events occurring as a result of working on their karts. Teams that do not resolve the issue(s) before their track time will have 10 minutes at the end of the day to run their kart if the safety and operational failure(s) have been remedied. Points normally awarded will be reduced by 50% if awarded during this time. Teams that do not attend Test Day may be ineligible to compete on Race Day at the discretion of the Race Organizers.

6.1.2 Race Day

Teams have until their track time to resolve any safety or operational issues resulting in a failure to pass inspection; however they may lose points during the day if they are unable to participate in other events occurring on Race Day as a result of needing to work on their karts. Teams must remedy the issue(s) and pass another safety inspection before their scheduled track time. Teams that fail to meet this deadline are ineligible to race on the track.

6.2 Safety Meetings

Safety meetings on Test Day and Race Day are mandatory for all team members including advisers and volunteers before teams can operate their karts.

6.3 Accidents

In the case of an accident causing severe personal injury or property damage, the applicable emergency service shall be called. (As mentioned in 6.5, a firefighter/EMT should always be present at test and race day.) In all cases of injury or property damage, event officials must be notified as soon as possible, but priority always falls to emergency personnel when applicable.

6.4 Changing Entry Data Sheets

Once a kart has passed safety inspection, no further structural changes are permitted other than those required or directly recommended by the Organizers on safety grounds.

6.5 Firefighters/EMT

A firefighter/Emergency Medical Technician (EMT) is onsite on both Test Day and Race Day.

Evaluation and Judging

7.1 Performance-Based Presentation (800 points)

All teams must present to other teams (optional) and to a panel of judges on Race Day. Presentations should follow these guidelines:

1. 5-7 minutes in length.
2. Supporting visual components such as: notebook, display boards, Powerpoint or similar
3. Presentation of build/design process, challenges in process and how these were addressed, how basic science, math, engineering and/or technology skills were used as part of the competition and what students learned from the competition.
4. Presentations should include a drawing and or photos of the design and build process.
5. See Appendix for scoring of presentations

7.2 Technical Review

All karts will undergo a two part technical review. The first is on Test Day and the second is on Race Day. Karts are inspected to ensure they meet the following criteria:

1. Compliance with all the requirements of the competition guidelines with respect to mechanical, structural, electrical and solar specifications, safety requirements and required documentation.
2. Trial run on test day to verify kart is road worthy and compliant with guidelines as detailed in Appendices.

7.3 Final Assessment and Awards

The purpose of the award system is to encourage teams to strive for learning opportunities and to reward a variety of positive outcomes. It is true in every racing discipline that compromise is not equal to failure. It's perfectly acceptable to design for one outcome and not another - for instance, a race car's designers must often find compromises between power and efficiency, weight and rigidity, drag and downforce. There is no more merit in one focus than another. Additionally, there is no less merit in a less successful design. Experience and teambuilding are two of the most important things in engineering and competition. The award system is based on the entire academic build process of the kart. See Appendix II for the points system. The criteria in the evaluation form will reflect the following assessments:

7.3.1 Grand Champion

The team that accrues the most points through the season, including Race Day.

7.3.2 Innovator Award

The team that designs the kart deemed by a majority of scrutinizers (by vote) to be the best in terms of functionality, design ideas, safety, or aesthetics, as examples. Innovations must be demonstrated and identified by the team in the final drawing submittals, progress checks, verbal presentations, and on Test Day and Race Day.

7.3.3 Speed Award

The kart having the fastest 3 lap average in each class. The 3 lap average is the average of the 3 fastest lap times.

7.3.4 Endurance Award

The team having the highest number of laps in their class.

7.3.5 Best Verbal Presentation

This award will be given to the team who is awarded the most points by the judges during their verbal presentation.

7.3.6 Spirit Award

This award will be given to the team judged by the Organizers to have the best competitive spirit through the season and/or being the most willing to help others.

7.3.7 Best Appearing Team and Kart

To the team with the best appearing kart and crew

7.3.8 Efficiency Award

To the team having the lowest deviation weighted on the number of laps in their class. It is based upon how well the kart uses the energy provided, either through batteries alone (standard and legacy class) or through solar panels only (maker class) by the time recorded for each lap and the number of laps.

7.4 Team Protest

Teams may protest penalties or scores by submitting a Grievance Form. Grievance Forms must be submitted to race organizers.

1. Grievance Forms must be submitted within 3 days from the time the team received a penalty or score with which they disagree.
2. Race Day Grievance Forms must be submitted within 30 minutes from the time the team received the penalty or score with which they disagree.

Penalties

Team's failing to comply with the rules and regulations may be penalized with a reduction of points. In addition, team's failing to comply may be disqualified at the sole discretion of the Organizers. Penalties incurred by a team member will be recorded and posted in the judge's evaluation form.

8.1 Non-Solar Charging of Batteries

Any team using an alternative means other than the solar panel provided to charge their batteries during competition will be disqualified.

8.2 Additional Batteries

Teams may not charge additional batteries for use during the competition on Race Day.

8.3 Speeding

Speeding or driving in an unsafe manner, including areas where kart operation is prohibited, such as the track parking lot or pits, is an automatic 100 point penalty. A team can be disqualified at the sole discretion of the Organizers for speeding, driving in an unsafe manner or in a prohibited location.

8.4 Team Conduct

Any inappropriate or unsportsmanlike conduct is subject to a 100 point penalty. Such conduct may include, but is not limited to, disrespect for judges and staff. Improper language, gestures, questionable attitude, cheating, and the use of tobacco products, alcohol, or illegal drugs will result in the application of this penalty. This regulation applies to any member of the team, including the teacher, adult chaperones, or team family members. Prescribed medications that will impair driving or inflict danger to the kart competition are strictly prohibited. This penalty will be applied at the discretion of the Organizers.

8.5 Failure to Comply with Regulations

Failure to comply with the rules and regulations in these guidelines are subject to a penalty. This includes both "in fact" and "in spirit" violations that could inflict danger to individuals or participants of the kart competition.