



2017-2018 Competition Rules©



THE UNIVERSITY OF ARIZONA
**TECH PARKS
ARIZONA**

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INTRODUCTION

Racing the Sun (RTS), is a solar go-kart competition organized and hosted by Tech Parks Arizona. The program seeks to foster and promote interest and skill development in STEM (Science, Technology, Engineering, and Mathematics) among high school students.

Solar go-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 energy like solar and electricity are 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.

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 on technical fields such as electrical and electronics, mechanical, construction or automotive skills. 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.

A teacher must be present while students are working on their karts or participating in events to mandate safe practices and safe kart operation at all times including on Test Day and Race Day.

1.2 Mentors

Mentors supplement the competition, provide guidance and help students acquire and understand the necessary technical knowledge needed for the solar go-kart for the competition. They support the classroom teachers and RTS staff. RTS mentors have a wide background of experience. Our mentors includes 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, and several graduate students from the University of Arizona.

1.3 Competition Organizers

The competition is organized by Tech Parks Arizona. Tech Parks Arizona 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. Tech Parks Arizona directs the UA Tech Park, The Bridges and the Arizona Center for Innovation with the highest priority of recruiting companies with connections to the UA to locate at these

facilities. Tech Parks Arizona is part of Tech Launch Arizona — a University of Arizona unit integrating technology commercialization, industry collaboration and the assets and activities of the Tech Parks with campus activities at the University of Arizona. For more information about Tech Parks Arizona, please visit www.techparks.arizona.edu.

1.4 Entry Registration

1.1.2 Registration

Each team participating in RTS must submit the following forms:

Team Application	September 6, 2017
Team Roster	September 6, 2017
Waivers Tech Parks Arizona Waiver Tech Parks Arizona Photo Release Musselman Honda Waiver	September 6, 2017
Registration Checklist	September 6, 2017

1. Team Application This is a commitment by the school and teacher to participate
2. Typed Team Roster listing all the members of the team along with their email addresses and phone numbers. The roster must be updated and resubmitted if team members change or are added.
3. Signed wavier forms for each listed person on the roster and anyone planning to attend TEST Day or RACE Day as a part of the team. Waivers must be sent in as new team members are added to the team.
 - i. Waiver Form for Tech Parks Arizona (3 pages)
 - ii. Photo Release for Tech Parks Arizona (1 page)
 - iii. Waiver Forms from Musselman Honda (Minor and Adult versions)
4. Registration Checklist with teacher signature

All waivers must be submitted by the final due date. We are not able to accept late paperwork, due to the complexity and number of students participating in the competition. Any student who attends Test Day or Race Day and does not have completed waivers on file in advance will be required to wear a colored wristband and sit in the grandstands. Without prior approved waivers, students are prohibited from working with their team. NO WAIVERS WILL BE ACCEPTED ON TEST DAY OR RACE DAY.

1.5 Cost of Competition

The competition cost is based on the overall cost of the competition divided across the teams participating. Each team will 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 must be received by Tech Parks Arizona prior to December 31, 2017. All fees are non-refundable.

The cost to participate in Racing the Sun for the 2017-2018 year is \$2,000 per go-kart. Teams needing to purchase a standard cart have an additional \$1,150 charge.

Racing the Sun competition fees include costs for workshops, events, track rental, room rentals, signage, marketing materials, legal fees and kart kit components. Fees this year also include lunch at both the fall workshop and on Race Day.

The component kit contains a motor, motor controller, throttle, watt meter, solar charge controller and 2 sets of batteries. One set of batteries will be supplied to the team at the beginning of the year for testing. A new set of batteries will be provided on Test Day to each team.

A standard chassis includes the chassis with roll bar, steering column, mounting brackets for the solar panel and tires.

1.6 Competition Schedule 2017-2018

All teams will have access to the necessary registration materials as listed in section 1.4 and the event schedule (see [Appendix II](#) Schedule and Points) prior to the registration deadlines. All necessary paperwork is available at the Teacher Orientation, or by contacting Brenda Hough at bhough@uatechpark.org

Late penalties and registration: A late fee of \$200 will be imposed for any registration paperwork submitted more than 5 days late. Teams that have not submitted all paperwork by September 14, 2017 may be ineligible to participate.

1.7 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.

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 cancellation will be provided via phone message and email 24 hours in advance should this situation arise.

1.8 Fundraising and Sponsorships

Fundraising is a vital aspect of 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; however the dollar amount allocated to the go-kart shall not exceed \$2,000. 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.

1.9 Waivers

Each member of the race team and all team volunteers and teachers must sign and agree to the terms stated on all required waivers and release forms. All forms for teachers and students are due by September 6, 2017. New students joining the team after September 6, 2017 MUST submit all waiver forms as they join the team. Any other volunteers such as parents or friends who wish to assist or join the team on Test Day or Race Day must turn in waivers NO LATER than 2 WEEKS prior to Test Day or Race Day.

RACE PROFILE

2.1 Race Classes

There are two classes of vehicles, which can be built and driven.

2.1.1 Standard Class

Teams may purchase a standard chassis for building the go-kart. No modifications are allowed to this chassis with the exception of adding the solar panel. 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 will be penalized or disqualified at the discretion of the organizers and judges.

2.1.2 Maker Class

Teams may 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, mentors, or judges.

2.2 Race Competition

Karts compete within the same class. For example, Standard Karts will not compete against Maker Karts. Race Day includes a trouble shooting challenge in addition to the race and inspections.

2.2.1 Rescheduling of Race Day

In case of inclement weather, the race may be rescheduled (see section 1.7 Events).

2.2.2 Race Day

Teams may arrive at the track no sooner than 20 minutes prior to registration. Late teams (more than 10 minutes) will be penalized in points. Exceptions may be made for justified extenuating circumstances at the sole discretion of the organizers.

2.2.3 Race Format & Winning Categories

On Race Day teams from each class will compete against each other on a 0.3 miles track to complete a maximum number of laps in 20 minutes. There are 8 winning categories. All teams are required to complete a minimum of 2 laps to be qualified to win in any category other than Grand Champion. The criteria for each category are described below:

- 1 Grand Champion: The team that accrues the most points throughout the entire competition including on Race Day.
- 2 Speed Winner Standard Class: The team completing the fastest lap will be the winner of this category.
- 3 Speed Winner Maker Class: The team completing the fastest lap will be the winner of this category.
- 4 Endurance Winner Standard Class: The standard class team completing the maximum number of laps in 20 minutes will be winner of this category. In the case of a tie for number of laps, the team completing the most laps in the shortest amount of time overall will be the winner.
- 5 Endurance Winner Maker Class: The maker class team completing the maximum number of laps in 20 minutes will be winner of this category. In the case of a tie for number of laps, the team completing the most laps in the shortest amount of overall time will be the winner.
- 6 Best Verbal Presentation: The team that receives the most points from the judges for their verbal presentation will be announced on Race Day.

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. 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.



Figure1: RTS Race Track (Highlighted in Blue)

MECHANICAL SPECIFICATIONS

3.1 Chassis

Two 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.

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 go-kart at the end of the competition, assuming they complete the competition and have paid all invoices. Teams competing with a standard chassis shall not modify the chassis other than to add items such as motors, controllers, electrical system, and solar panels. 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.

3.1.2 Maker Class

A chassis may be built to the requirements specified in Sections 3 and 4, Mechanical Specifications and Safety Regulations respectively.

Teams may use a chassis from a prior year; however, all current year requirements must be implemented. Specified parts mandated by the organizers must be used. These parts are detailed in section 3.2. The team will retain ownership of the go-kart and all components at the end of the competition. All karts must be reviewed and approved by mentors, judges, and the competition organizers 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 maker karts are subject to mentor and race organizer review. The major components of the solar go-kart (structure, body, solar panel, battery compartment, motor mount, drive system, electrical system, suspension, running gear, etc.) must be exclusively designed and constructed by the students. The structural development and fabrication of the solar go-kart shall follow the regulations listed below:

3.2.1 Structure

Safety is the primary concern in the construction and competition of each go-kart. Insufficient regard for structural safety will result in disqualification from the event during scrutineering on Test Day or Race Day. The structural development and fabrication of the solar go-kart will have the following criteria:

3.2.2 Physical Dimensions

Teams shall not modify the size of the standard chassis.

For maker karts, the distance between the centers of two tires on the same axle is known as track width (Rtrack and Ftrack) as shown in the Figure 1. The minimum track width is 38" and the maximum track width is 54". The minimum wheelbase of the go-kart shall be 60".

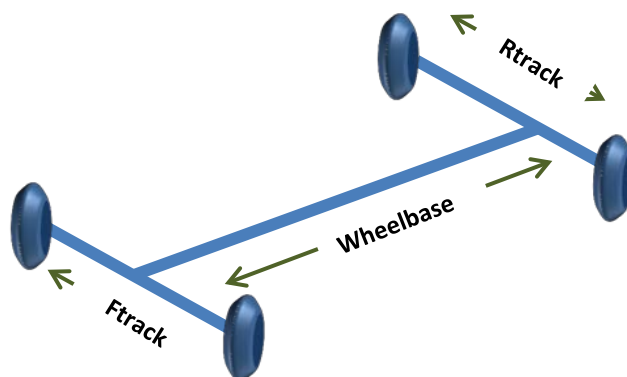


Figure 1: Wheelbase (measured between rotational centers of wheels)

3.2.3 Wheel Requirements

1. The solar go-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 of the go-kart shall be arranged such that they are symmetrical around the vehicle centerline with respect to its left and right sides.

3.2.4 Brakes

All solar go-karts must be equipped with a functional and properly mounted braking system and must be able to stop repeatedly. Operation of the primary brake system should not result in un-commanded turning of the cart. Brakes will be tested twice by applying 100 lbs of force while being pulled forward. Tires shall not move while being tested. Brake components will not be provided by the organizers. This rule will be strictly enforced.

3.2.5 Roll CAGE

A roll cage provides protection surrounding the driver in case of a collision or roll over. All go-karts are required to 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 must be at least 2" of clearance in all directions between the roll cage and the driver seated in an upright position. Upright position is defined as the driver seated at a 45 to 90 degree angle in the kart.
- 3 Teams shall demonstrate roll cage compliance on Test day and Race Day.
- 4 The roll cage tubing must be a minimum of 1".
- 5 The mechanical drawings should include the dimensions of the roll cage to illustrate how it protects the driver in case of a collision.
- 6 See samples for guidance, [Appendix VII](#)

3.2.6 Roll BAR

The roll bar is the structural frame member that extends above the driver's head, protecting the driver in the event of a roll-over. There must be at least 2" of clearance in all directions between the roll bar and the driver's head (with helmet on) while seated in the normal driving position. Welded to frame – The roll bar must be welded to the frame at no less than two points on each side of the driver to brace the bar from bending forward or backwards. The roll bar must be an integral part of the frame and cannot be removed. The roll bar tubing must have a minimum outside diameter of 1". See samples for guidance, [Appendix VII](#)

3.2.7 Ground Clearance

On test day all go-karts will be tested by driving over a 3" speed bump. No part of the go-kart shall touch the speed bump except the wheels.

3.2.8 Go-Kart Numbering –

Each go-kart will be given a number. Placement and size of the number will be determined by the track managers. Teams are also encouraged to indicate their school name and colors on their go-kart.

3.2.9 Weight of the Solar Go-Kart

A solar go-kart is weighed with all components that will be part of the kart during the race with the exception of 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.

3.2.9.1 Standard Class Weight

Teams competing in the **standard class** are not required to meet a minimum weight for the vehicle as most alterations to the kart are prohibited in this class

3.2.9.2 Maker Class Weight

Teams competing in the maker class are required to meet a minimum total kart weight of 100 lbs. (excluding the driver).

3.2.10 Power

Solar radiation received directly by the solar array is the only power source that can be stored or used for propulsion with the exception of the batteries provided by the organizers.

Components provided to the teams by the organizers include:

Component Name	Specifications/ Dimensions	QTY
Solar Panel	77" x 38" $\pm 3"$.	1
Motor	Type: brush Voltage: 24 volt dc Rated speed: 2500 rpm Rated current: 27.4 amp Sprocket: #25 chain 11 tooth Output: 500 watts Length: 5-1/4" Width: 4-1/4" Shaft length: 1" Inside throttle diameter: 7/8" Wire length: 61"	1
Motor Controller	Voltage: 24 volts Wattage: 1000 watts	1
Watt Meters	MICTUNING DC 6.5-100V 0-100A LCD Digital Display Ammeter Voltmeter Multimeter Volt Watt Power Energy Meter Blue with 100A/75mV Shunt	2
Batteries	6 Volt/4.5 Amp Hour Sealed Lead Acid Battery with 0.187 Fast-on Connector	4
Charge Controller	RioRand (TM) MPPT RR1210RN Solar Charge Controller Regulator 12/24V INPUT 10A	1

NOTES: 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.

3.2.11 Auxiliary Devices

Any device used to assist the start, stop, or powering of a solar go-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 solar go-kart or re-charge their batteries. Use of duct tape or other temporary means to the go-kart are not allowed. Proper attachment of auxiliary devices is the responsibility of the team. Teams shall insure all the auxiliary devices are firmly secured and attached to the go-kart. "Push start" of a solar kart on Race Day is prohibited.

SAFETY REGULATIONS

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

4.1 Seating Position

Proper seating of a go-kart driver positions the driver's head above, behind, and higher than the driver's feet and facing forward. A driver's seating angle should 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. A Driver fully reclined or positioned flat (or close to it) in the go kart is not permitted. 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.**

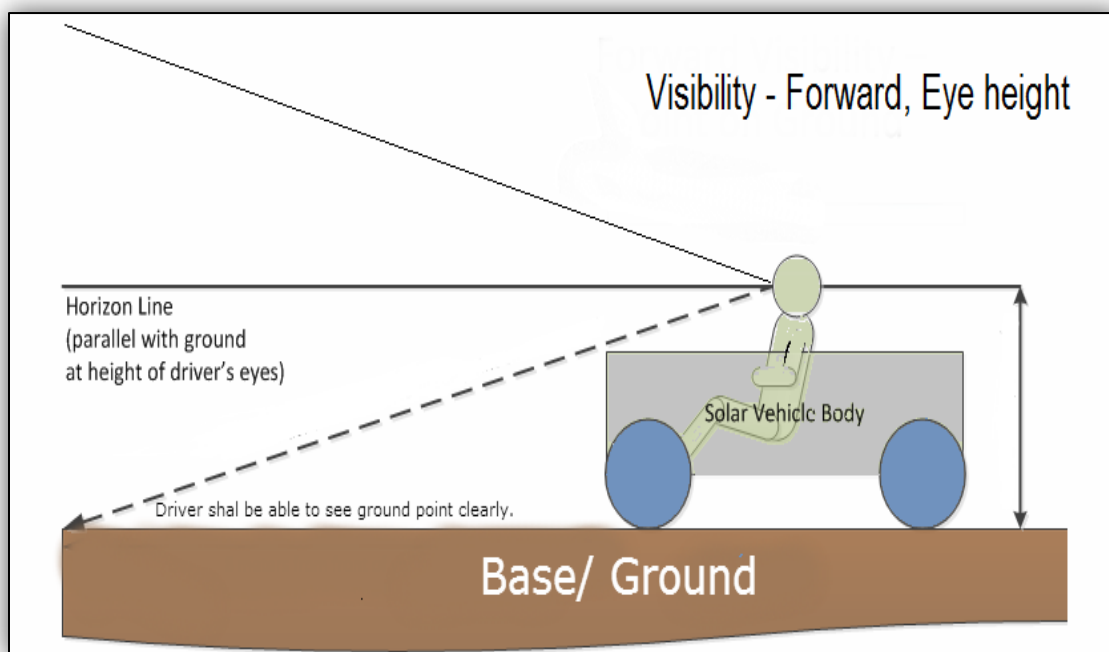


Figure 2: Seating Position and Visibility

4.2 Visibility

All go-kart drivers must be able to see with minimal obstructions. Drivers must have clear visibility of traffic to the front, left, right, and back. All go-karts must include a rear-view mirror attached to the frame.

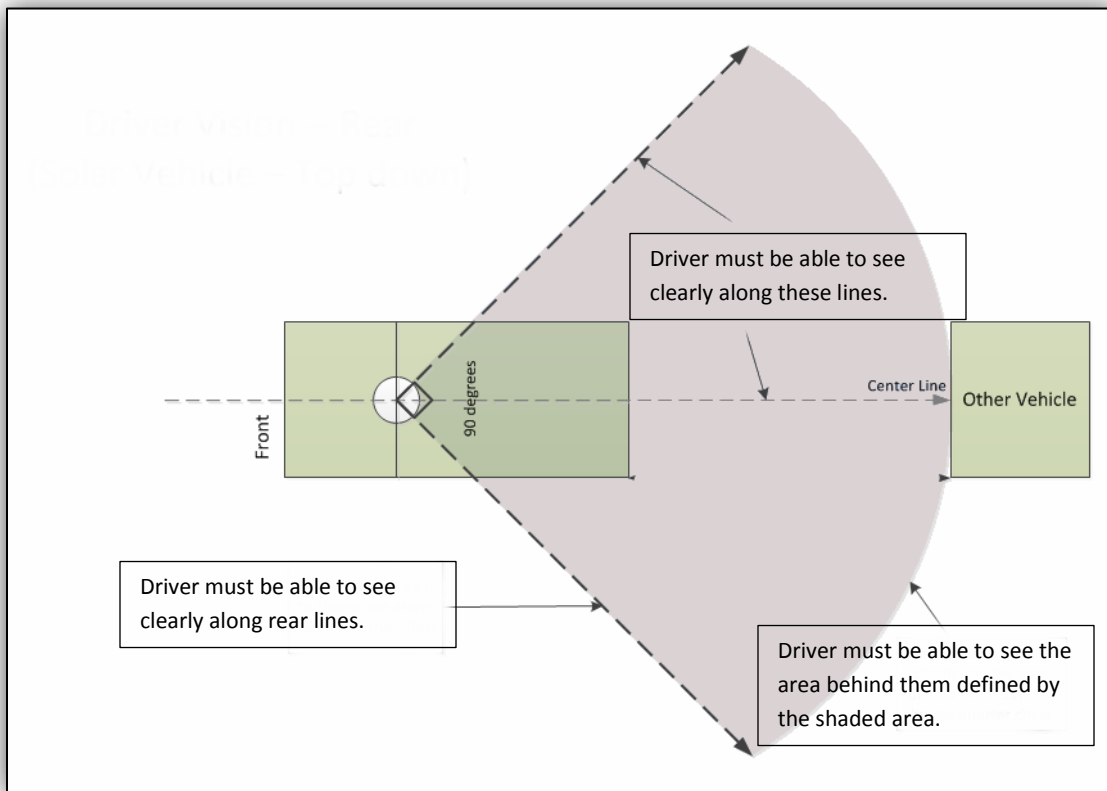


Figure 3: Driver Vision (Rear Top)

4.3 Bumpers

All karts must be fitted with a front and rear bumper to cover the metal parts of the chassis and providing a cushion or buffer as well as cover for any sharp edges from fabrication.

4.4 Belly Pan

The cockpit must be equipped with a full belly pan to isolate the driver from the road. Feet must not be able to touch the ground while seated in the go-kart. A driver must not be able to extend a leg to the side or front and touch their foot to the ground while driving.

4.5 Covers and Shields

All revolving and moving parts of the solar go-kart (especially parts that are within reach of the driver) must be covered to prevent accidental contact. Only operating controls shall be accessible to the driver. This requirement is verified on Test Day and Race Day.

4.6 Safety Belts

All solar go-karts must be equipped with a shoulder and lap harness safety belt. The use of safety belts is mandatory any time a vehicle is moving. The safety belt system must be permanently attached to the chassis of the solar go-kart. The upper end of the shoulder belt must be connected to an appropriately rigid mounting point which is higher than the driver's shoulders.

4.7 Electrical Shock Hazards

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

4.8 Battery Fuse

Battery fuses are required to be installed in all the solar go-karts. Fuses are tested on Test Day and Race Day. Teams purchase their own fuses.

4.9 Electrical Wiring

A wiring diagram must be provided to RTS organizers per the schedule specified in [Appendix II](#). 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. Teams purchase their own wiring.

4.10 Brakes

All solar go-karts must be equipped with a functional and properly mounted braking system and must be able to stop repeatedly. Operation of the primary brake system should not result in un-commanded turning of the cart. Brakes will be tested twice by applying 100 lbs of force while being pulled forward. Tires shall not move while being tested. Brake components will not be provided by the organizers. This rule will be strictly enforced.

4.11 Battery Container/Cover

Batteries are contained in a secured and firm housing. This is verified on Test Day and Race Day to ensure compliance with competition rules.

4.12 Steering

All go-karts must have competent steering systems. 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.

4.13 Turning Radius

Solar karts must be able to make a U-turn in a 15-meter wide lane in each direction.

4.14 Speed

The maximum allowable speed for a go-kart is 25 mph. This is verified with a radar gun or monitors used by the race track. Any team in excess of the allowable speed is ineligible to compete if the team cannot slow the kart down to an acceptable speed.

4.15 Emergency Stop Switch (aka Kill Switch)

All go-karts must include an emergency stop switch at both the back of the go kart and near the driver that is capable of cutting all power to the motor, either by directly disconnecting the motor or by releasing a normally-open relay through which all motor current flows. These switches must be red and labeled "Emergency Stop". Teams provide their own emergency stop switches.

4.16 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. Driver safety measures include, but are not limited to:

4.16.1 Helmets

A full helmet encompassing the entire head of the driver with face and eye protection worn by the driver at all times when the go-kart is in operation.

4.16.2 Eye Protection

All helmets must include a full face mask.

4.16.3 Clothing

All team members are required to 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 sole discretion of the race organizers and race day mentors. Suitable clothing includes, but is not limited to:

- 1 Long pants such as jeans providing protection from the waist to the ankle. Pants with holes or other like fashion adornments along with spandex, lightweight fabrics, or extreme bell bottoms are not permitted
- 2 Long-sleeved shirt covering the entire length of the arm from shoulder to wrist
- 3 Gloves
- 4 Closed-toe shoes and socks that cover the ankle. High top shoes are recommended. Flip flops or sandals are not permitted.

4.16.4 Driver Training

Every driver participates in driver training. Training entails safety awareness, maneuvering techniques and etiquette. Driver training is provided by the race track organizer.

4.16.5 Non- Permitted Driving

Drivers drive on the race track only. The go-kart is 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 checks points, positioning on the track or any other situations. Teachers will escort their team at all times. If a school has more than one team, then the teacher is responsible to provide an adult to escort those additional teams.

4.16.6 Drafting (Tailgating)

Drafting by a solar go-kart is prohibited. A solar go-kart is drafting if it follows another go-kart from a distance less than or equal to 250" for more than a 5 second interval.

4.16.7 Passing

Drivers pass other vehicles as directed by Musselman Honda. Failure to do so may result in a point penalty or disqualification of the team.

4.16.8 Safety Belts

All solar go-karts must be equipped with a shoulder and lap harness safety belt. The use of safety belts is mandatory any time a vehicle is moving. The safety belt system must be permanently attached to the chassis of the solar go-kart. The upper end of the shoulder belt must be connected to an appropriately rigid mounting point which is higher than the driver's shoulders.

4.17 Teacher Responsibility

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

TEAM SUBMITTALS

Students gain valuable experience planning the go-kart project, drawing an electrical schematic and a mechanical drawing. Engineering drawings communicate ideas and information, and clearly define the requirements for the solar go-kart. Teams that begin construction of their kart before electrical and mechanical approvals may have to re-design their kart based on requirements mandated by the organizers and officials.

5.1 Project Plan

All teams submit a project plan. Submission is via email 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 go-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 due date as specified in [Appendix II](#). An updated project plan includes milestones with dates, required materials or parts for design and construction, and a fundraising plan identifying funding sources. (See [Appendix VII](#) for scoring sheet and additional details.)

5.2 Electrical Drawings

All teams shall submit a complete schematic diagram showing the electrical layout of the go-kart. The electrical drawing must be submitted via email 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 will not receive any points. Business hours are Monday-Friday 8am-5pm.

An Electrical drawing includes wiring for the propulsion, solar, instrument, and battery systems. Mentors score drawings as detailed in [Appendix VIII](#). Students with guidance from a teacher are responsible for the design of the electrical system.

5.3 Mechanical Drawings

A mechanical drawing is a detailed drawing showing the go-kart frame and construction and the mechanical assembly of the system. The mechanical drawing must be submitted via email 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 will not receive any points. 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 as detailed in [Appendix IX](#). Students with guidance from a teacher are responsible for the design of the mechanical system.

5.4 Data Sheets and Notebook

Teams will document structural, mechanical and electrical design and changes occurring during fabrication. Details include: type of material, gauge of wire and other components. The notebook is a documentation of all changes and results of those changes during fabrication.

Teams in the maker class are required to submit a data sheet along with their mechanical drawing with all go-kart specifications. The go-kart specifications include anticipated weight (to be affirmed on Test Day), structural dimensions, motor type, solar cell type, solar panel power output, battery type and capacity, braking systems, and wheel type (See [Appendix I](#)).

SAFETY GENERAL

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

Each race team will be responsible for road-worthiness of their solar go-kart. All solar go-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 solar go-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 regulations test would include the presence of the driver and back up driver along with proper safety gear (clothing, full face helmet, etc.).

Teams must pass the safety inspection in order to operate their go-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 go-kart if the safety and operational failure(s) have been remedied. Points normally awarded will be reduced by 50% if awarded during this time. Any team unable to drive their kart on Test Day using the solar panels will be assigned to a rear position in the line-up on Race Day. 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. Teams that performed satisfactorily on Test Day and were able to run on the track will line up in front positions on Race Day. Teams that did not run on Test Day will line up in rear positions.

6.2 Safety Meeting

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

6.3 Accidents

All injuries or accidents must be reported to an event official immediately. In the case of an accident involving personal injury and/or property damage, notification of the appropriate emergency personnel will have priority. Failure to comply with this guideline may result in expulsion from the event.

6.4 Changing Entry Data Sheets

Once a go-kart has passed safety inspection, no further structural changes are permitted other than those identified as being a safety issue.

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

All teams will present on or prior to race day. Presentations should follow these guidelines:

- 1 5-7 minutes in length.
- 2 Supporting visual components such as: display boards, Power Point 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 V](#) for scoring of presentations

7.2 Technical Review

All solar go-karts will undergo a two part technical review. The first is on Test Day and the second is on Race Day. Go-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 go-kart is road worthy and compliant with guidelines as detailed in this document ([Refer to Appendix III and IV](#)).

7.3 Final Assessment

The award system will be based on the entire academic build process of the solar go-kart. See [Appendix II](#) for the points system. The criteria in the evaluation form will reflect the following assessments:

- 7.3.1 Grand Champion: Team securing maximum points out of a total of 10,000 points will be the winner in this category. Accumulated points will be emailed to teams throughout the year. On Test day and Race day mentors and technical experts will score teams based on Test Day points ([Appendix IV](#)) and Race Day points ([Appendix III](#)). Race Organizers reserve the right to change the scoring forms if necessary in order to rectify errors. Teams will be notified if such changes occur and all attempts will be made to minimize changes.
- 7.3.2 Speed Race Winners - Teams in each class completing the fastest lap will be the winners of this category. Transponders placed on the kart by track staff are the primary method to determine the winners in this category.
- 7.3.3 Endurance Race Winners –Teams in each class completing the maximum number of laps in 20 minutes are the winner of this category. Transponders placed on the kart by track staff determine the winners in this category. In the event of a tie the kart completing the laps in the least amount of time overall is declared the winner.

- 7.3.4 Best Presentation:** A panel of judges determines the best presentation based on the performance of each team (Refer to [Appendix V](#)).

7.4 Rules for Judges

Mentors can also serve as judges on Test Day and Race Day. In addition, the race organizers may bring in additional volunteers to serve as judges. Judges and/or Track Staff must enforce all safety rules set out in these guidelines. Judges will adhere to the following rules:

- 1 Judges (including mentors) are prohibited from working exclusively with one team or school. Any judge violating this rule will be immediately removed from the event.
- 2 Technical experts are prohibited from using favoritism tactics for the entire solar go-kart competition.
- 3 Judges must record notes, comments, and infractions in their evaluation forms. Poor record keeping will lead a judge to be removed.
- 4 All technical experts will be informed of any team protest. All alleged infractions committed by a judge will be reviewed by a selected panel.

7.5 Team Protest

Teams may protest penalties or scores by submitting a Grievance Form ([Appendix VI](#)). 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

Any team failing to comply with the rules and regulations of these guidelines may be penalized with a reduction of points. In addition, team's failing to comply could be disqualified at the sole discretion of the organizers. All penalties incurred by a team member will be recorded and posted in the judge's evaluation form.

8.1 Disturbing Official Battery Seal

A battery seal broken without official supervision, in a manner that would allow battery access is an automatic penalty of 100 points.

8.2 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.

8.3 Additional Batteries

Teams may not charge additional batteries for use during the competition on Race Day. Each team will be provided with a new set of batteries on Race Day.

8.4 Speeding

Speeding or driving in an unsafe manner including areas where kart operation is prohibited is an automatic 100 point penalty. A team can be disqualified at the sole discretion of the competition organizers for speeding, driving in an unsafe manner or in a prohibited location.

8.5 Interruption of Race

If a kart leaves the track at any point during the operation of a race, the kart is disqualified for that race. As time permits teams who were unable to successfully complete the race can return to the track to run, but no points will be given.

8.6 Team Conduct

Any inappropriate or un-sportsman-like 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. Prescribed medications that will impair driving or inflict danger to the solar go-kart competition are strictly prohibited.

8.7 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 solar go-kart competition.

APPENDICES

APPENDIX I: Data Sheet

Racing the Sun Technical Data Sheet		
High School:		Team Photo <input type="checkbox"/>
Faculty Advisor:		
Team Members: _____ _____ _____ _____		
Driver and Back up Driver:		
Mechanical Features	Specifications	Additional Information
Length		
Width		
Height		
Weight (TBD on Test Day)		
Wheelbase		
Body		
Suspension		
Wheels		
Tires		
Brakes		
Electrical Features		
Solar Cells		
Array Peak Rating		
Motor		
Peak Power		
Operating Range		
Maximum Speed		
Inverter		
Power Tracker		
Battery		
Other Features		

APPENDIX II: Schedule & Point System

Event/ Challenge	Day/Date	Notes	Time	Notes or Objective	Total Points
Teacher Orientation	Wednesday August 9, 2017		3:30-5:30 PM	Describe Racing the Sun competition to teachers. Provide Competition Rules. Review important dates, milestones, competition rules, scoring, etc... Conference call option available. Mentors are welcome.	n/a
Team Application Due	Wednesday September 6, 2017		4:00 PM	Teachers submit "Team Application" signed by lead teacher and Principal, via email. This is basically an "intent to participate".	100 - Deduct 25% for each day late
Team Rosters & Waivers Due	Wednesday September 6, 2017		4:00 PM	Teachers submit "Team Roster" & Waivers via email w/min. 5 students to participate. (10-15 students preferred).	100-Deduct 25% for each day late
First Diagnostic Survey Due	Thursday September 21, 2017		4:00 PM	Survey Monkey link will be provided on 9/9. *	275-Deduct 25% for each day late All students must submit for full points.
Saturday Workshops*	Saturday September 23, 2017	Saturday Travel Necessary	9:00 AM-2:30PM	Provide teachers and students skills and insights into how to build a solar go-kart and how to compete in the competition.	800- Full points awarded for 75% student participation
Workshop Satisfaction Survey	Friday October 6, 2017		4:00 PM	Survey Monkey link will be provided on Wednesday 9/27. *	275-Full points awarded for 75% student participation. Deduct 25% for each day late.
DRAFT Project Plan Due	Friday October 27, 2017	Submit as PDF	4:00 PM	Teams submit a Draft Project Plan. Project Plan workshop to be provided on 9/23/2017.	300-Deduct 33% for each day late. Feedback provided only to teams that turn this in on time.
DRAFT Submittals	Friday November 17, 2016	Submit as PDF	4:00 PM	Teams submit Draft Electrical Schematic & Draft Mech/Design Drawing. Workshop provided on 9/23/2017.	350 points each-Deduct 33% for each day late. Feedback provided only to teams that turn these in on time.
Submittal Feedback	Friday December 1, 2017	Mentor Feedback	4:00PM	Score and feedback on submittals provided to teams.	100 points awarded to each team if Mentors don't deliver.
FINAL Submittals	Friday December 15, 2017	Submit as PDF	4:00 PM	Teams submit Final Electrical Schematic, Final Kart Mech/Design Drawing, and Final Project Plan. (Worth 300, 350 & 350 respectively).	1000-Deduct 33% for each day late.
Final Feedback	Friday January 10, 2017	Mentor Feedback	5:00 PM	Score and feedback provided for all team submittals.	100 points awarded to each team if Mentors don't deliver.
Design Review (Tucson)	Wednesday February 7, 2018	Weekday Travel Necessary	2pm-5pm	Students present status of project, discuss individual roles and learning experiences. Students ask questions. Teachers provide feedback. Organizers judge progress of teams and provide mentor support and guidance to teams.	1000 - More details to follow
Design Review (Phoenix)	Friday February 9, 2018	Weekday Travel Necessary	8:30am-3:00pm	See above	see above
Career Day	Wednesday February 21, 2018	Weekday Travel Necessary	TBD (All Day Event)	Teams visit and tour STEM related organizations such as Raytheon, IBM, Global Solar and UA Labs. Students consider how STEM education and careers could fit into their future.*	500-Full points for 5 or more students participating-Deduct 100 points for each student below 5.
Test Day	Saturday April 7, 2018	Saturday Travel Necessary	9:30-noon	Dress rehearsal for Race Day. Teams go through safety checklist with mentors, test their karts on the race track and get driver training. All students must wear safety gear.	1500
Verbal Presentations (TUCSON)	Wednesday April 18, 2018	Weekday Travel Necessary	3-6 PM	Students present build process to panel of judges. Students share successes, learning experiences and challenges and gain public speaking experience.	450
Verbal Presentations (PHOENIX)	Friday April 20, 2018	Weekday Travel Necessary	3-6 PM	See above.	see above
Last Diagnostic Survey	Fri., April 27, 2018		4:00 PM	Survey Monkey link will be provided on April 20. *	225
Student Satisfaction Survey	Fri., April 27, 2018		4:00 PM	Survey Monkey link will be provided on April 20. *	225
Race Day	Saturday May 5, 2018	Saturday Travel Necessary	9:00 AM-2:30PM	Compete for Speed, Endurance, and Grand Champion. Family friendly community event with awards ceremony.	2550
Teacher Survey	Wednesday May 10, 2017			Survey to be provided on Tuesday May 8, 2017	
TOTAL POINTS					10000

Please note there are 6 required field trips. *Scores will be based on participation.

APPENDIX III: Race Day Points

TEAM NAME:					
Race Day Points	Description	Max. Points	Points Received	Comments	
Participation	Team arrives on time	1	75		
Driver Safety Gear					
	Full Head Helmet	2	25		
	Long sleeve shirt & Long pants	3	25		
	Close-toed shoes	4	25		
	Gloves	5	25		
Car Requirements	Chassis dimension: Track width 38"-54" and wheelbase min: 60"	6	25		
	4 wheels on ground, symmetrical about center line	7	25		
	Roll Cage: fixed, driver's head has clearance in all directions	8	25		
	Ground clearance 3"	9	25		
	Visibility (front, left, right, back) and rearview mirror	10	25		
	Appropriately constructed seat	11	25		
	Safety belt attached to chassis	12	25		
	Revolving/moving parts covered	13	25		
	Voltage stickers on solar panels	14	25		
	Electrical Wiring--secured	15	25		
	Electrical Wiring--insulated	16	25		
	Steering system is operational and safe	17	25		
	Kill Switch meets requirements	18	25		
	Battery fuses meet requirements	19	25		
	Battery container and/or cover	20	25		
	Other as per Judges	21	0		
	Functional Brakes & Manueverability	22	25		
	Weight minimum 100 lbs (excluding driver)	23	25		
	Speed Winner	24	600		
	Endurance Winner	25	600		
	Efficiency Winner	26	600		
	Troubleshooting Exercise	27	150		
RACE DAY Subtotal			2550		

APPENDIX IV: Test Day Points

Test Day Points	Description	Max. Points	Points Received	Comments
Registration				
Participation	Team arrives on time, with kart and goes through all stations	125		
INSPECTOR NAME:				
	Full Face Helmet	45		
	Long sleeve shirt	45		
Driver Safety Gear	Long Pants	45		
	Close-toed shoes	45		
	Gloves	45		
	Chassis dimension: Track width 43-53" and wheelbase min: 60"	45		
	4 wheels on ground, symmetrical about center line	45		
	Belly Pan meets requirement	45		
	Adequate Brakes	45		
	Roll Cage: fixed, driver's head has clearance in all directions	45		
	Ground clearance 3"	45		
	Weight minimum 100 lbs (excluding driver)	45		
Car Requirements	Visibility (front, left, right, back) and rearview mirror	45		
	Appropriately constructed seat	45		
	Safety belt attached to chassis	45		
	Revolving/moving parts covered	45		
	Voltage stickers on solar panels	45		
	Electrical Wiring--secured	45		
	Electrical Wiring--insulated	45		
	Steering system is operational and safe	45		
	Kill Switch meets requirements	45		
	Battery fuses meet requirements	45		
	Battery container and/or cover	45		
	Turning radius as per rules	45		
	Other as per Judges	45		
	Kart runs on racetrack	250		
	Race Day TOTAL	1500		

APPENDIX V: Presentation Score Sheet



High School: _____

Team Name: _____

Type of Kart: _____

Introduction of Team, Team Members and roles	50 points	_____
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Description of Design Concepts	100 points	_____
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- Structural elements (25)
- Mechanical elements (25)
- Electrical elements (25)
- Use of solar energy (25)

Discussion of major challenges and fundraising	60 points	_____
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Organization of presentation (logical, coherent) (Opening, Body, Closing)	40 points	_____
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Quality of presentation materials	40 points	_____
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Involvement of team Members in Presentation	40 points	_____
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Response to Questions	60 points	_____
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What did you Learn	60 points	_____
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Total Points	(450 points)	_____
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Notes:

Name of Judge: _____

APPENDIX VI: Grievance Form

Email or hand deliver the below form to: Brenda Hough

(bhough@uatechpark.org) or Molly Gilbert (mgilbert@uatechpark.org)

<p>Name of Grievant: _____</p> <p>Name of High School: _____</p> <p>Faculty Advisor: _____</p> <p>Grievance Summary:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>If applicable, cite Rules & Regulations Part and Section Number violated: _____</p> <p>_____</p> <p>Did grievant meet with a RTS representative prior to submitting this grievance form?</p> <p><input type="checkbox"/> yes</p> <p><input type="checkbox"/> no</p> <p>Grievant Signature _____</p> <p>Date _____</p>
--

APPENDIX VII: Project Plan Scoring

Section One/Basic Data must include:

School Name	10 points
Team Name (if more than one kart per school)	10 points
Date of Submission	10 points
All team member names with DOB	15 points
Team positions/job titles or primary duties	15 points
Work schedule	15 points

Section Two/Timeline must include:

Timeline with key dates for planning, fundraising, building and testing	20 points
RSVP dates; 2 weeks prior to all official organized events	20 points
Dates of every event or deadline listed in competition rules	20 points
Interim dates for research, design, planning, building and testing	15 points

Section Three/Building Materials must include:

Items needed to build kart, general description. All items not provided by organizers.	15 points
Cost of items needed	15 points
Estimated time of arrival (if you can't get the items locally)	15 points
Supplier	15 points
Total cost	15 points

Section Four/Fundraising must include:

Name of Fundraising Manager	15 points
List of fundraising activities or events	15 points
Dates associated with activities or events	15 points
Students assigned to manage and volunteer	15 points
Names of students who prepared the project plan	15 points

Total points for project plan 300

Note: A template for the project plan will be provided to all teams.

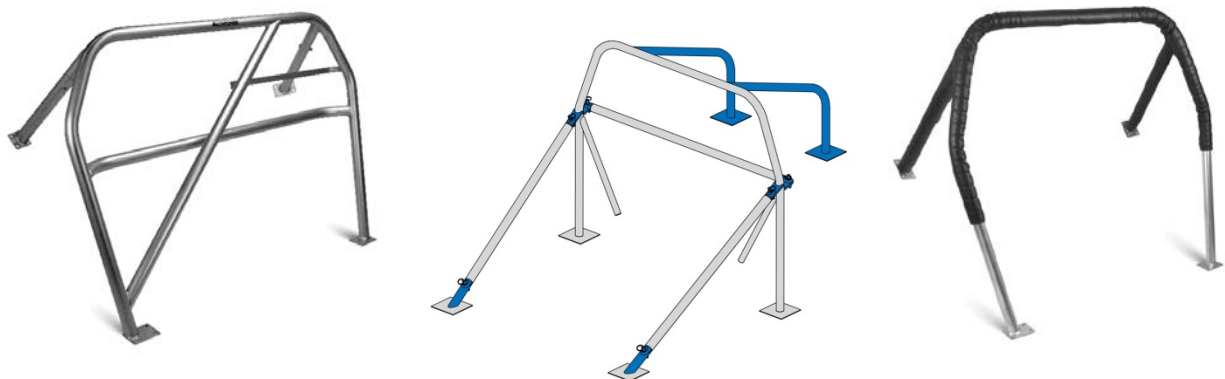
APPENDIX VIII: Team Submittal – Electrical Drawing Scoring

Electrical Grading Sheet			
		Point Awarded	Points Received
Turned in on time			75
	Deduct 5% for each day late		
Drawing Labels			
	Did the file name adhere to the rules?		10
	Were the team members all listed?		10
	Were the key students who worked on the drawing listed?		10
	Was the School Name included?		10
	Was the "Team Name" included?		10
	Was the date of submittal listed?		10
Drawing Clarity			
	Were straight lines straight?		10
	Were standard shapes drawn correctly (i.e. circles or squares)		10
	Were dimensions easy to read?		10
	Was the drawing neat or sloppy?		10
	Was the text easy to read?		10
Drawing Requirements			
	Are the wires color coded?		15
	Do the wires overlap excessively?		15
	Are all positive and negative connections shown?		15
	Is the wire gauge indicated?		15
	Is the fuse size indicated?		15
	Are the fuses in the proper locations?		15
	Are the components wired effectively (does it function safely)?		15
	Would the kart function as wired?		15
	Are the components labeled correctly?		15
	Is there a kill switch		15
	Is the kill switch in the proper location?		15
Total for Electrical			350

APPENDIX IX: Team Submittal – Mechanical Drawing Scoring

Mechanical Grading Sheet		
		Points Awarded
Turned in on time		
	Deduct 5% for each day late	75
Drawing Labels		
	Did the file name adhere to the rules?	10
	Were the team members all listed?	10
	Were the key students who worked on the drawing listed?	10
	Was the School Name included?	10
	Was the date of submittal listed?	10
Drawing Clarity		
	Were dimensions easy to read?	15
	Was the drawing generally neat or sloppy? (lines straight, circles round,...etc...)	10
	Was the text easy to read?	15
Drawing Requirements 1		
	Is there a full kart front view?	10
	Is there a full kart side view?	10
	Is there a full kart top view?	10
Drawing Requirements 2		
	Are the necessary dimensions shown?	15
	Are the tires shown or described?	10
	Indication of Brakes/Type, location?	10
	Indication of Suspension/location or n/a?	10
	Gear Ratio indicated?	10
	Is the datasheet included w/proposed weight and other key items?	10
	Are the roll bar and roll cage shown?	10
	Is the location of the batteries indicated?	10
	Are the materials indicated?	10
	Are the key components shown or labeled?	10
	Solar Panel Shown and labeled?	10
	Is the method for attachment of the Solar Panel shown or indicated?	10
	Are there any details?	10
	Was the ground clearance shown?	10
	Is every drawing or view dimensioned?	10
	Total for Mechanical	350

APPENDIX X: Roll Bar and Roll Cage



Acceptable Roll Bar Examples ↑



Acceptable Roll Cage Examples ↑

APPENDIX XI: Request for Variance

Directions: Fill in the below information and submit to the below emails:

bhough@uatechpark.org
mgilbert@uatechpark.org

Name of School: _____

Name of Teacher: _____

Name and email of team coordinator:

Requested modification or variation to go-kart:

Purpose of modification or variance request:

