BTSA

High School Competition Handbook

2021-22

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Flight Challenge

Overview

Participants analyze flight principles with a rubber band powered model aircraft.

Challenge

Build, fly, and adjust (trim) a model to make long endurance flights inside a contained airspace. Any model design is acceptable if the model complies with the event specifications. All models are to be built and test flown before the event date.

Eligibility

- Entries are limited to five (5) teams per school, 1 member per team.
- Entries must be started and completed during the current school year.

Procedure

1. Participants are provided a minimum of thirty (30) minutes for trim flights at the event site.
2. Models are evaluated for specification compliance during the trim session. Time allotted for the trim portion may be extended according to the number of participants and site scheduling.
3. Participants have two (2) opportunities to fly their models for official times.
4. Participants attend a pilot's meeting to review the sequence for making the official flights.
5. In an orderly fashion, participants wind their models and proceed to a group timer for permission to fly.
6. Participants place their models on the floor and wait for the signal to release from the timer. Timing begins when the model rises off the ground.
7. Flight time ends when models hit the floor/ground or when they touch an obstruction.
8. No repairs are allowed after time trials begin.
9. Each participant has the times of two (2) official flights recorded by the timer.

Regulations

1. Models are to be made of wood and tissue paper for fuselage and flying surfaces (wings, fin, and stabilizer). No plastic foams, films, or condenser paper are allowed.
2. Models use a commercially available plastic propeller or propeller assembly: minimum of 140mm to a maximum of 170mm in diameter. Trimming or thinning propellers is allowed to achieve balance and/or to reduce weight.
3. Fuselage dimension: minimum of 300mm in length measured with prop assembly attached.
4. Wingspan: maximum of 50cm horizontally projected, wing chord 12cm projected.
5. Rubber motor: maximum weight of motor is one (1) gram, including the O-ring. No length measurement is made. Spare motors are allowed during the official fights. One rubber O-ring may be used on the rubber motor loop at the motor hook end for easier handling of wound motors.
6. Model weight: minimum of 7 grams, maximum of 21 grams. Models are weighed without motors attached. Clay is permitted for trim ballast. (Model is weighed with clay ballast.)
7. Steel wire may be used only for propeller shaft, motor hook, and landing gear.
8. The two wheels must be a minimum of 15mm in diameter of plastic or wood and they must roll.
9. Acceptable flight support equipment includes the following:
    1. Mechanical rubber motor winders (Electricity may not be available at every site.)
    2. A winding stooge may be used to anchor the model while its motor is being wound.
    3. The landing gear must support the airplane without sagging in its rested position.

Evaluation

- Evaluation is based on the duration of flight. A bonus of ten (10) seconds is added to the flight time per flight if the airplane successfully lands on its wheels and comes to a rest on its wheels.
- The times posted during the time trials are used to determine the three (3) top times.
- Following the second flight, the three (3) top combined times' models are awarded 1st, 2nd, or 3rd place.
- Ties are broken by determining the longest single flight time.

Hydro Rockets

Overview

Students will apply aerodynamic principals and construction methods to design and build a rocket that will achieve the longest hang time without the use of a parachute.

Challenge

Using necessary materials, participants will build a rocket out of plastic soda bottles at their school. Rockets will be launched on competition day. The objective is to have the rocket with the longest hang time - time in air from launch to landing without the use of a parachute.

Eligibility

- Each school may enter Five (5) rockets - one (1) student per rocket.
- Rockets must be designed and built in the current school year.
- All work is to be completed at the participant's school.
- Repairs may be made by students but no changes to designs.

Requirements

- Rocket must be launched from a Pitsco Hydro Port Launcher.
- Standard mouth on bottle - no 3L or Gatorade bottles, they won't fit on the launcher.
- Fins cannot obstruct the function of the launcher.
- No weight or size restrictions.
- Students will decide the amount of water to add to their bottle for launch.
- ONLY water may be used in the bottle for launching.
- Pressure regulator will be set to 80psi, student may launch before full pressure is attained.
- Participant will pull their launch cord.
- Students will be responsible for setup, launch and full recovery (all your pieces) of rockets.
- NO PARACHUTES. Streamers must be less than 1 inch wide.
- Rockets that do not fit on the launcher will be disqualified.

Material Regulations

- Rockets can be made from any blow molded plastic bottle, 2L, 1.5L, 1L, 20oz or 16oz that will fit on the launcher.
- Green bottles are OK but not recommended.
- NO water bottles.
- NO PVC or metal pipes.

Evaluation

Launch will be timed with a stopwatch from initial launch until the rocket hits the ground. Rockets that land on roof tops or get stuck in trees their time ends when the rocket touches an obstruction or leaves the sight of the judge.

Logo Design

Overview

Participants will demonstrate proficiency with graphic design software to produce multipurpose graphics.

Challenge

Students will design a new logo for the "Broward Technology Student Association" to be used in printing, web, and large format output. Each student will submit one logo design. The single design should be demonstrated in color, grayscale, and line (black & white).

Eligibility

- Each school may enter three (3) logos - one (1) person per logo.
- Logo must be made during current school year.
- Entries will be submitted one 1 week prior to the contest.

Procedure

Participants will submit a presentation board with single design demonstrated in color, grayscale, and line art.

Evaluation

Metric	**Worth**
Impact	20pts
Design Elements	
• Balance (visual weight of design elements)	5pts
• Dominance (eyes are drawn to main message)	5pts
• Proportion (size relationships within the design)	5pts
• Unity (design elements flow together)	5pts
Font - readability, eye appeal, size, placement, etc.	10pts
Technical - Line Art, Grayscale, and Color versions.	30pts
• Line art in vector format	10pts

CNC Challenge

Overview

Students will apply their design, measuring, and manufacturing knowledge and skills to create a mating part to a piece revealed the day of the competition.

Challenge

Students will demonstrate their aptitude of Mastercam/Fusion 360 software and the DaVinci CNC mill. A complex geometric part will be revealed to competitors. It will be their job to measure part, then create a negative that can mate with the piece. The first three students to create a part that meets the criteria will be awarded gold, silver, and bronze respectively.

Procedure

- The part will be revealed to the competitors.
- Students will be allowed to measure the part.
- Students will draft the part in the CAD/CAM software of their choice.
- When finished drafting, students will bring their file to the Davinci for milling.
- Students then bring their piece to be judged.

Evaluation

1. The student's piece must mate with the competition piece with no gaps or overhangs greater than 1/8th in. (~3mm).
2. The student's piece must meet the minimum width, height, depth, and weight requirements.

Trebuchet

Overview

Students will apply their knowledge of simple and complex machines to design, construct and test a trebuchet powered by a counterweight or a catapult powered by torsion.

Challenge

Participants will use research and design to develop a machine that will throw an object as far as possible as well as maintain accuracy. Students will build, test, and refine their machines at their school and conduct several test throws the day of the event. Students must construct their entry from scratch. No kits please.

- Awards for two categories, Distance & Accuracy

Eligibility

- Entries are limited to three (3) machines per school, four (4) students per team.
- Must be designed and constructed during current school year.
- Each device will compete in only one category.

Design Parameters

- Maximum throwing arm length of 40 inches.
- Maximum total height of 4 feet.
- Powered by torsion, counterweight, bungie, rubber tubing, and/or springs.
- Materials and construction must be deemed "safe" by instructor and judge.
- Minimum throw distance six (6) feet. Each machine can have only one firing apparatus. Participants will provide their own projectile, enabling the device to be tuned to the projectile.

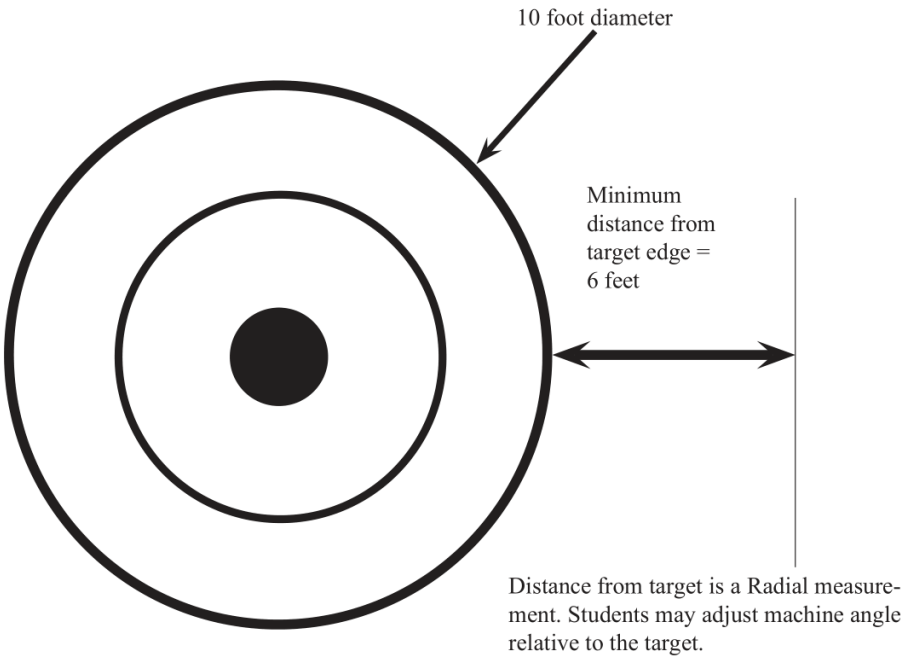
Procedure

1. Participants report to event coordinator at the designated time and place for the event.
2. Participants should bring enough ammunition to practice and compete, do not depend on reusing your projectile.
3. Participants will then attempt five (5) throws from behind the designated foul-line.
4. Target will be flat on the ground ten-foot circle with concentric rings. Outer ring worth 2 points. Middle ring, six-foot diameter is worth three points. Bulls eye target one foot diameter worth five points. Successful launch missed target worth one point. Participants choose the location of the target. Target may not be relocated.

Evaluation

- Points will be awarded for distance thrown, the longer the distance the more points.
- Points will be awarded for accuracy; each throw will be given the points marked on the target that was hit.
- All points will be combined to give the final score, highest score wins.
- Scoring Formula: a * (d - 6) where "a" is the accuracy score according to Procedure point 4. and "d" is distance measured in feet. Example: a bullseye hit at 10 feet would be 5*(10-6) = **20** points.

Figure 1a



Increase distance from target for additional points. Each additional foot from target .5 points to score.

Robotics - VEX Tipping Point

Overview

Students will demonstrate their robotics design, building, programming, and driving skills through the VEX Robotics Tipping Point competition format

Eligibility

Entries are limited to two (2) machines per school, four (4) students per team. Must be designed and constructed during current school year.

Design Parameters

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Procedure

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Evaluation

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* *All the 2021-22 VEX Robotics rules will be used. You can find these rules on the VEX and RECF websites:* https://content.vexrobotics.com/docs/21-22/tipping-point/GameManual2.0.pdf

Bridge Design

Overview

Using the necessary materials provided, participants will build a model of their structure while working at their school. These structures will be destructively tested on the BTSA site to determine the efficiency of their design.

Purpose

Design & construct a model that reflects knowledge of strength and construction concepts meeting the design constraints.

Eligibility

School Entries are limited to five (5) - one (1) person teams.

Time Restrictions

- Bridges and design plans must be completed in the current school year.
- All work is to be completed at the participants' School & participants are to have their completed bridges and design plans present on the day of the BTSA Competition.

Requirements

1. Students are to create a series of drawings for the building of their bridge.
2. All the drawings should be presented in 1 of 3 formats: Hand Drafting, AutoCAD, or any 3D design CAD/CAM program.
3. All Plans are to have 2 Views of the bridge presented, Top, Front.
4. All plans are to have parts labeled and be dimensioned for reference by the judges.
5. Test plate is to be attached after bridge construction and should be glued to the bed.

Material Regulations

Students are only allowed to use the following materials.

- 1/8" x 1/8" Balsawood Sticks - Available from Pitsco or Midwest Solutions 2" x 6" Test plate made of 1/4" Plywood.
- Glue - Green Pitsco Structures Glue only - Glue may not be applied to the structure as coating, it may only be applied at the joints or along Lamination Lines.
- Material quantities are not limited for this competition. (Please note evaluation method)
- No painting or coating wood pieces.

Bridge Specifications

Overall Length	12-inch MAX (+/- .125 inch)
Span	6 inch - between abutments (+/- .125 inch)
Width	3" MAX (+/- .125 inch)
Superstructure Height	1-inch MIN.
Bed	2-inch MIN.
Abutments	2-inch MAX

- Thru Hole:
  - 1-inch unobstructed thru hole located in the center of bridge bed. From the top view no portion of the thru hole can be obstructed by any part of the bridge.
- Test Plate:
  - Use provided plate only. Placed on the bed of the bridge after construction.

Construction Techniques

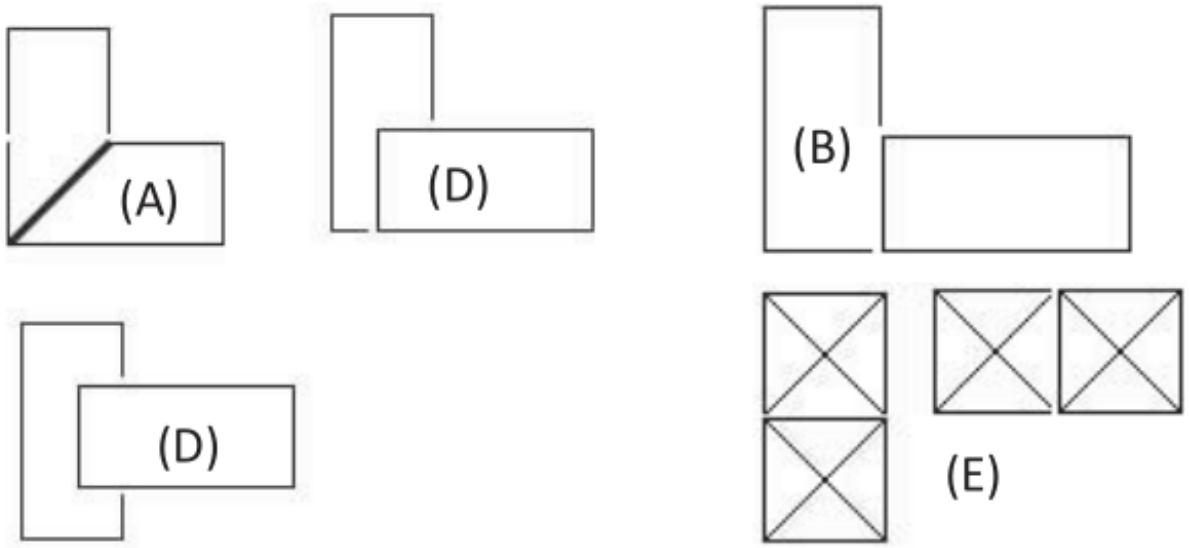
- The Testing platform must be centered on top of the bridge bed.
- The testing platform must have a hole 1 inch diameter bored in the center.
- There can be no more than two pieces of wood glued perpendicular to each other. *See lamination below.*
- Paper gussets made of cardstock can be used to reinforce joints, Max gusset size .25 x .25 inch
- The roadway must have enough clearance to allow the testing staff to slide a 1" X 2" X 8" block of wood onto the deck for testing.

Joining Pieces

Acceptable Methods

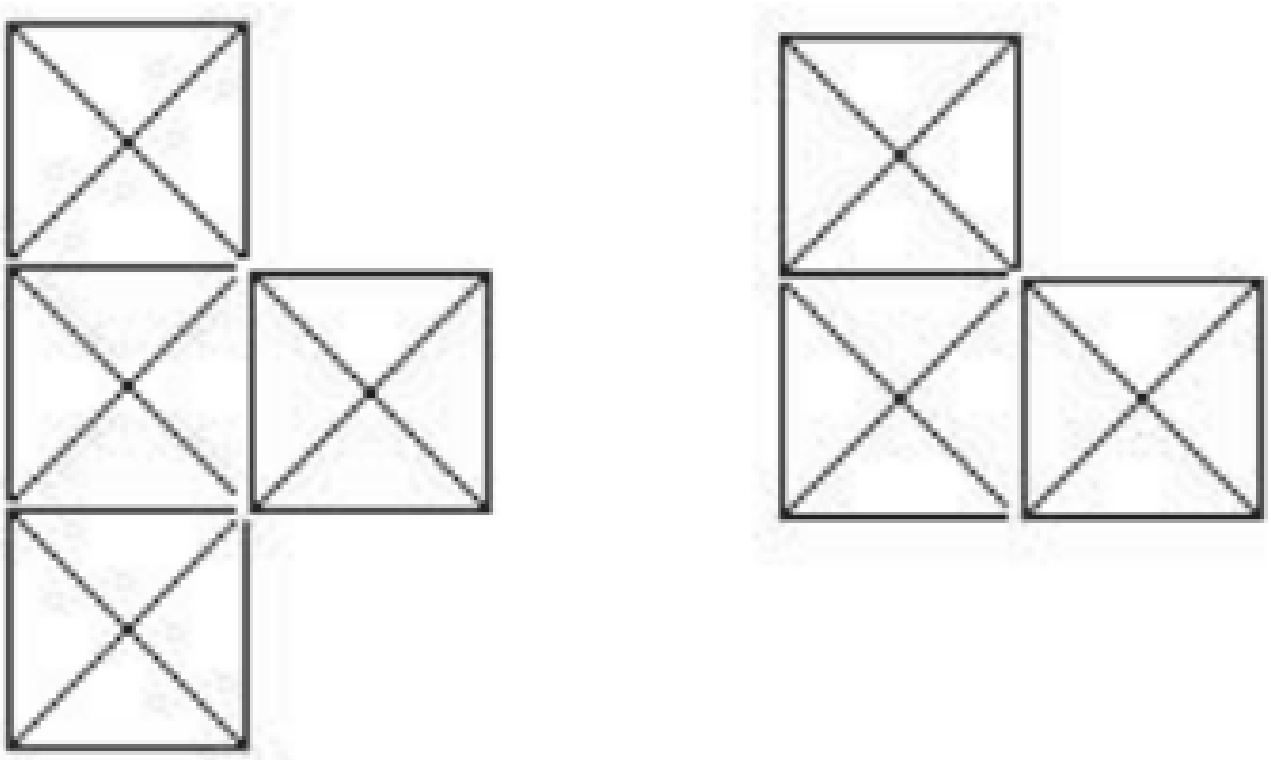
- A. Mitering
- B. Butting
- C. Lap (overlap)
- D. Notching
- E. Double Laminating

Figure 2a



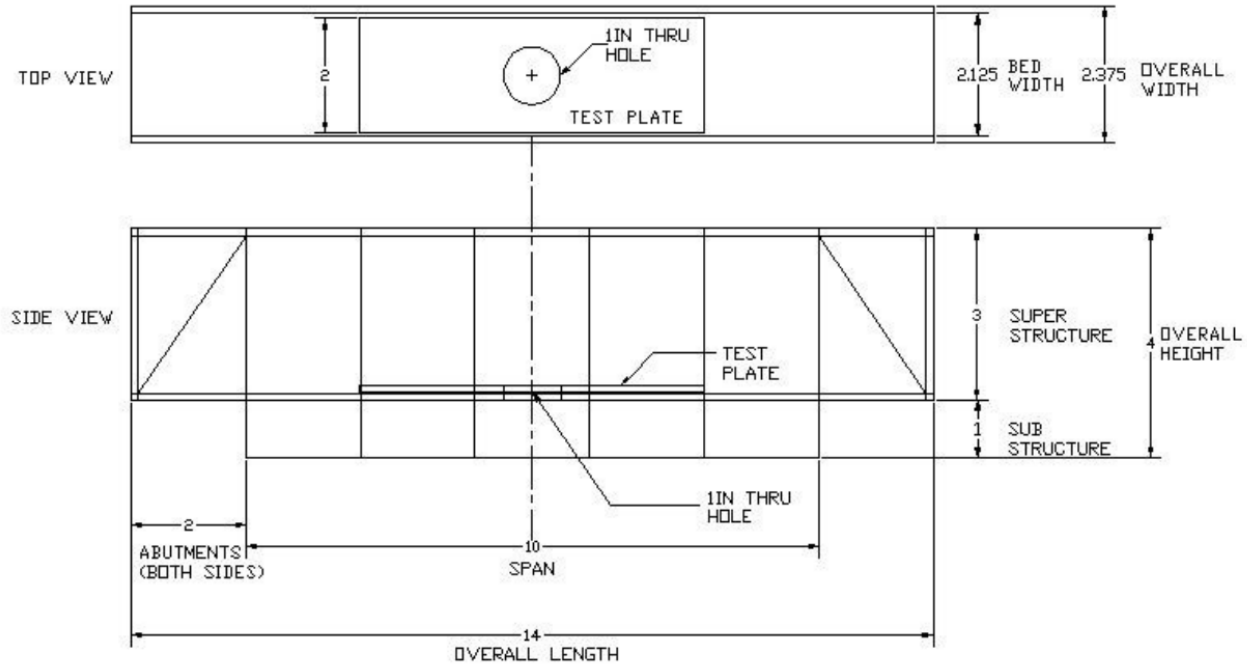
Not Allowed - Triple Laminating - No more than 2 pieces may be laminated together.

Figure 2b



Bridge Tester

Figure 2c



Co2 Dragster

Overview

Participant's design, produce working drawings, and build a CO2-powered dragster.

Challenge

Design and produce a fast CO2-powered dragster according to stated speculations and using only certain materials. Minimum vehicle weight 52 grams.

Eligibility

- Entries must be started and completed during the current school year.
- Entries are limited to six (6) individually produced dragsters per school.
- Each dragster may only enter one (1) category.
- Dragster completion is separated into three categories.
    - Open wheel,
    - Closed (shell) wheel - can be CNC or handmade.
    - Unlimited - Category is not limited by materials or weight limits. Must be strong enough to be safe. If it is safe it will race.
    - 1 Special Award - Best Paint (worth 1 point for club award) Procedure
- Entries are reviewed by evaluators to determine, among other things, safety on the track.
- Safe dragsters are staged and raced by judges for official time on the raceway.
- The top three (3) qualifying cars in each category are evaluated against the criteria for this event.
- Dragsters that do not meet event regulations are disqualified. Regulations
- The official distance between the start line and the finish line on the racetrack is twenty (20) meters.
- No repair or maintenance is allowed after the entries have been registered.
- Any entry damaged during the race is evaluated by the event coordinator to determine whether the vehicle is allowed to race again.
- If the vehicle is damaged by the conference personnel, the event coordinator rules as to whether the vehicle may be repaired by the student entering the vehicle. This is the only reason a student is allowed to touch his/her vehicle after registration.
- Undamaged wheels that come off during the event may be replaced as determined by the event coordinator.
- All CO2 cartridges for the race are provided by national BSTA.
- Dragsters that do not meet the following specifications/tolerances are disqualified from the race.

Dragster Body

One-piece, all-wood construction. Any type of lamination results in disqualification. No add-ons such as body strengtheners, fenders, plastic canopy, exhausts, or air foils may be attached to or enclosed within the vehicle. Fiberglass and shrink wrap are considered body strengtheners and cannot be used on the car body for any reason. Decals may be used for decoration only; they may not be used to gain an aerodynamic advantage, i.e., decals cannot cover the exterior axle holes or be used to cover open areas of the body. Two (2) or more like or unlike pieces of wood glued together are not considered one-piece, all-wood construction.

Specifications

Body

Specification		Imperial		Metric
-------	Min	Max	Min	Max
Body length	8 in	12 in	200 mm	305 mm
Body height (with wheels)	3 in	n/a	75 mm	n/a
Body mass (completed car without CO2)	1.5 oz	n/a	42 g	n/a
Body width at axles, front and back	1.375 in	1.65 in	35 mm	42 mm
Vehicle total width (including wheels)	3.5 in	n/a	90 mm	n/a

Axles/axle holes/wheelbase

Specification		Imperial		Metric
-------	Min	Max	Min	Max
Bottom of axle bearing above bottom of car	0.196 in	0.39 in	5 mm	10 mm
Rear axle hole from rear of car	0.394 in	3.875 in	9 mm	100 mm
Wheelbase (axle distance apart at farthest points)	4.133 in	10.629 in	105 mm	270 mm

- Dragsters must have two (2) axles per car, no more, no less
- Bearings, bushings, and lubricants may be used.
- Glue may be used to secure bearings to body.

Spacer washers/clips

- Spacer washers 8 max
- Axle clips 8 max
- Silicone adhesive or any other type of glue/adhesive may not be used in place of wheel clips to hold wheels or axles in place.

Power plant (CO2 cartridge hole)

Specification		Imperial		Metric
-------	Min	Max	Min	Max
Hole depth	1.88 in	2.125 in	48 mm	54mm
Safety zone thickness	0.125 in	n/a	3mm	n/a
Chamber diameter	0.748 in	0.787 in	19 mm	20 mm
Lowest point of chamber to race surface (with wheels)	1.023 in	1.574 in	26 mm	40mm

- The power plant hole must be at the farthest point at the rear of the car and must be drilled parallel to the racing surface to assure proper puncture of the CO2 cartridge.
- A minimum of 3mm thickness around the entire power plant hole must be maintained on the dragster for safety.
- The inside of the power plant hole must not be painted.

Eye screws

Specification		Imperial		Metric
-------	Min	Max	Min	Max
Inside diameter	0.118 in	0.196 in	3 mm	5mm
Distance apart (at farthest points)	5.9 in	10.629 in	150 mm	270 mm

- Dragsters must have two (2) screw eyes per car that meet tolerances, no more.
- Screw eyes must not contact the racing surface.
- The track string must pass through both screw eyelets, which are located on the center line of the bottom of the car.
- Glue may be used to reinforce the screw eyes.
- It is the responsibility of the car designer/engineer to see that the eye screw holes are tightly closed to prevent the track string from slipping out.
- As with all adjustments, this must be done prior to event check-in.

Wheels

Specification		Imperial		Metric
-------	Min	Max	Min	Max
Front diameter	1.259 in	1.456 in	32 mm	37 mm
Front width (at surface contact point)	0.078 in	0.197 in	2 mm	5 mm
Rear diameter	1.181 in	1.574 in	30 mm	40 mm
Rear width (at surface contact point)	0.472 in	0.708 in	12 mm	18 mm

- A dragster must have four (4) wheels, no more, no less.
- Two (2) wheels must meet specifications for SMALL wheels.
- The other two (2) must meet the specifications for LARGE wheels.
- All four (4) wheels must touch the racing surface at the same time.
- All wheels must roll.
- Wheels must be made entirely from plastic.
- Dimensions must be consistent for the full circumference of the wheel.

Evaluation

- Evaluation for time trials is based on the speed of the car.
- The three fastest dragsters in each category.