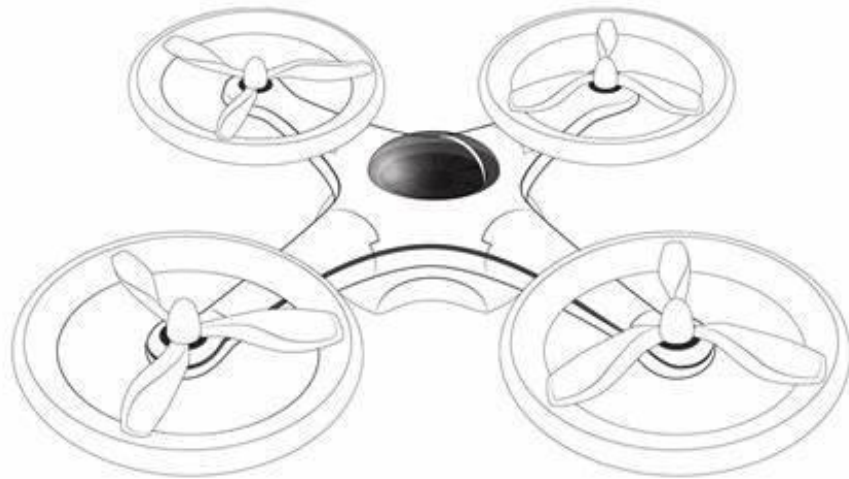




Unmanned Aircraft System (UAS) Challenge

Guidelines



November 2023

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UNMANNED AIRCRAFT SYSTEMS (UAS)

PURPOSE

Unmanned Aerial Vehicles (UAV), miniature pilotless aircrafts, flying mini quad-copters and drones, are rapidly becoming common household products around the world. Due to the exponential growth of the UAV industry, kids and teens may now explore, learn and evolve along with the applications of today and the discoveries of tomorrow. UAVs are the competitive and educational platform for kids and teens to become familiar with and learn more about the many facets of UAVs, robotics, and the future of this growing industry and how it applies to real life and future opportunities.

NOTE: UAVs must be approved according to Florida Statute 934.50

UAS CHALLENGE PURPOSE

The goal of the UAV competition is to promote and develop students' experiences and expertise in regards to UAVs, instill a sense of curiosity, confidence and teamwork within the areas of Science, Technology, Engineering and Mathematics (STEM).

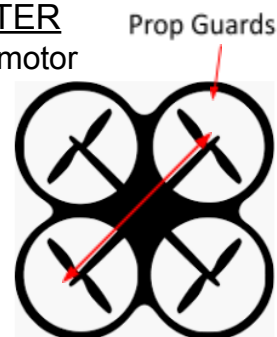
UAS / DRONE TEAMS

UAV / Drone teams may consist of minimum of two (2) to a maximum of three (3) students and each school is only permitted two (2) teams (exception is Jr/Sr high schools, they may have two (2) middle school teams and two (2) high school teams).

Teams will elect one (1) pilot, one (1) spotter and optional (1) runner/mechanic to fly in each heat. The pilot, spotter or runner/mechanic can be the same individual, or a different student for each heat; teachers or adult parents or siblings are NOT allowed to be pilot/s, spotter/s or runner/mechanic/s.

ALLOWABLE UAV SPECIFICATIONS FOR MICRO / MINI-QUADCOPTER

- Max length 190 mm (~7.5 inches) measured diagonally from motor to motor
- 4-8 battery powered motors
- 1, 2, or 3-cell LiPo battery
- No greater than 250 grams (~0.55lbs) including batteries attached
- No wheels are allowed; landing skis or arms are ok
- Propellers guards are required (see picture example to the right)
- Home built drones are preferred (prebuilt/prefab kits are allowed).



- FPV is allowed but likely detrimental to succeeding in the competition (FPV Frequencies will be checked prior to flying the heat and drones must be capable of quickly switching frequencies and power ratings upon request of a judge).

SUGGESTED UAV SPECIFICATIONS FOR MICRO/ MINI-QUADCOPTER

- a. Use remote control operated drones for command and control. It is suggested to avoid WiFi and/or Bluetooth enabled smart devices for command and control as connectivity is less reliable than a remote control. UAV teams using WiFi and/or bluetooth do so at their own risk.



is preferred to



TOOL BOX

The following is a suggested list of UAS and toolbox items

- a. Extra blades/propellers
- b. Batteries, Charged
- c. UAV controller with batteries
- d. Power strip for battery charger
- e. Tools required for working on UAV
- f. LiPo battery charger with balance, charge, discharge and storage functions
- g. Extension cord

SAFETY

FLIGHT SAFETY DURING COMPETITION

- a. Pilots may not fly in an intentionally dangerous manner
- b. Pilots may only fly their drone within the hot zone of the competition field
- c. Teams may only fly their drone when instructed to do so by a field referee
- d. Pilots will be asked to force land or ground their drone if its flight course poses a threat to any individuals or goes beyond the boundaries of the playing field
- e. If applicable, the fail safe must be activated
- f. The transmitter must be placed on the table and remain untouched when a team member is connecting a battery to the drone and/or placing it on the field
- g. The transmitter must stay off unless given the okay by the Event Director to engage to "on"
- h. UAS teams will adhere to all safety rules and directions of game officials; if teams do not adhere to flight safety, this will result in an immediate disqualification

BATTERY SAFETY

- a. Team members should always be present during the charging of a lithium polymer battery
- b. Follow good LiPo treatment practices:
 - i. Do not discharge batteries below 30% (3.7 volts per cell)
 - ii. Do not charge batteries above 90% (4.2 volts per cell)
 - iii. Always charge and store batteries inside fireproof containers
 - iv. Never charge a battery that is puffy, leaking fluids or punctured
 - v. Never charge faster than 1C (1 times the amperage of the battery). Stop Charging immediately if a battery heats up or starts to emanate smoke
- c. Lithium Polymer battery fires are chemical fires that do not require oxygen to burn, so if a battery ignites:
 - i. DO NOT pour water on the battery; doing so only makes the fire worse
 - ii. DO NOT place the battery in a sealed container to smother the fire
 - iii. DO NOT use a standard household fire extinguisher
 - iv. DO place the battery in a bucket of sand to smother the fire; one will be provided as a safety precaution (Used to separate the burning battery from causing damage to the surroundings. NOT to protect the UAV)

UAS RACING TERMS

- a. DNS: Did Not Start - Aircraft fails to cross start gate
- b. DNF: Did Not Finish - Aircraft fails to complete all requirements set out by the respective competition guidelines
- c. DQ: Disqualified - Disqualification parameters outlined herein
- d. Termination: Removal from event
- e. OOB: Out Of Bounds - The drone exceeds the specified area for each respective track design; discretion by judges will be used in order to complete the competition pattern if the drone lands OOB's; the team spotter will be responsible in resetting the drone in the designated locations in order to continue with competition pattern
- f. DRONE: Dynamic Remotely Operated Navigation Equipment
- g. Drone reference: UAV, Quad, Mini-Quad, Quad-Copter, Mini-Quad-Copter
- h. UAV: Unmanned Aerial Vehicle

JUDGING AND MARSHALING

- a. All events will be managed by an appointed team of judges
- b. All specified events will be described by the head-judge prior to the start of each session
- c. Each event will be monitored by judges and/or marshals to maintain fair competition
- d. In the event of a mid-air collision, pilots can resume the event if they are able to take off again without intervention; if the drone exceeds the specified area for each respective track; design discretion by judges will be used in order to complete the flight pattern; the team spotter will be responsible in resetting the drone in the designated locations in order to continue with completion pattern otherwise their heat is considered a DNF
- e. Any practice or behavior deemed unsafe, i.e. erratic and uncontrolled flying will result in an immediate disqualification
- f. All floor decisions made by Event Director or Judges are final and **NOT** open for after event appeals

DISQUALIFICATIONS

- a. Any pilot not physically present on the flight line fully prepared to race at the time of their scheduled heat will receive a DQ for that heat and will not receive a rerun
- b. Any practice or behavior deemed unsafe, i.e. erratic and uncontrolled flying will result in an immediate disqualification
- c. No celebration laps or excessive displays of celebration while race heat is still active; any interference caused by a pilot or airframe will result in a DQ for that heat
- d. Two (2) or more DQ's will result in termination from the event
- e. Un-sportsman like conduct will **NOT** be tolerated and will result in termination from the event
- f. All floor decisions made by Event Director or Judges are final and **NOT** open for after event appeals

GENERAL GUIDELINES

- a. Unlawful flight, such as flights near an event at locations where flying is prohibited, can result in disqualification from the event; there is no flying outside the specified competition area
- b. All pilots must be able to demonstrate effective Fail-Safe procedures defined by the Event Director; in most cases this is a "Drop" method, where the drone will immediately cease flight by stopping all motors and operation if it loses contact with the radio transmitter
- c. All pilots must have an "ARMING" position switch or sequence on their radio; the drone should not power up by any accidental controls from the radio; drone arming must be executed via a control switch
- d. Pilots will not power up transmitters unless instructed to do so, e.g. Event Director has given approval to take part in a race; **powering up a transmitter at all other times may result in an immediate termination from the event**
- e. All drones **NOT** on active competition are required to be in the "off-mode" to prevent the possibility of frequency interference

COMPETITIONS & TEAMS

PAYLOAD FERRY MISSION

This is a race between two (2), three (3) or four (4) UAV teams to a designated bowl containing a single ¼ inch ball bearing through a course that is marked out by a series of gates, slalom flags, and/or landing area/s. The objective is to retrieve this steel ball bearing with a weight of approximately 1 gram from the bowl and bring it back to the starting bowl without dropping the ball. The UAV takes off from the starting bowl, concluding the race by landing and releasing the ball bearing back on their starting bowl. Pilots will begin on a starting area, signaled with a countdown to start the race. The team who finishes first with a ball bearing in their starting location disconnected from their drone, is the winner for that bracket and will advance to the next bracket, until a winner is determined (see fig 1.0). In the event that all teams are unable to complete the task of recovering the ball bearing, the winner defaults to whomever was able to land back at the home bowl first.

PAYLOAD BONUS

If a team desires, ten (10) ball bearings will be in each bowl. This is to allow return flights to pick up these steel bearings in the case of dropping them. HOWEVER, if a team chooses to pick up more than one ball, each additional bearing after the first will result in a 5 second time reduction upon completion of the course.

DOWNSIDE

If a team drops a ball bearing that is carrying more than one, that team will suffer a 10 second time increase.

TIPS

Teams may use servos, electromagnets, magnets, tape, or any other grabbing mechanism they desire. Teams need to keep in mind weight, power, and programmability required to pull off this feat. The goal of this event is to encourage design and innovation with current and personally built UAV's. Previous competitions for racing have only demonstrated pilot skill. Here we would like to also highlight the team's ability to innovate as well.

If teams/school desire to build their own UAV's, minimum possible hardware specifications include an F4 flight controller, Betaflight/Mission Planner or equivalent software, and 3in propeller/motors. The rest of the components can be any combination of things.

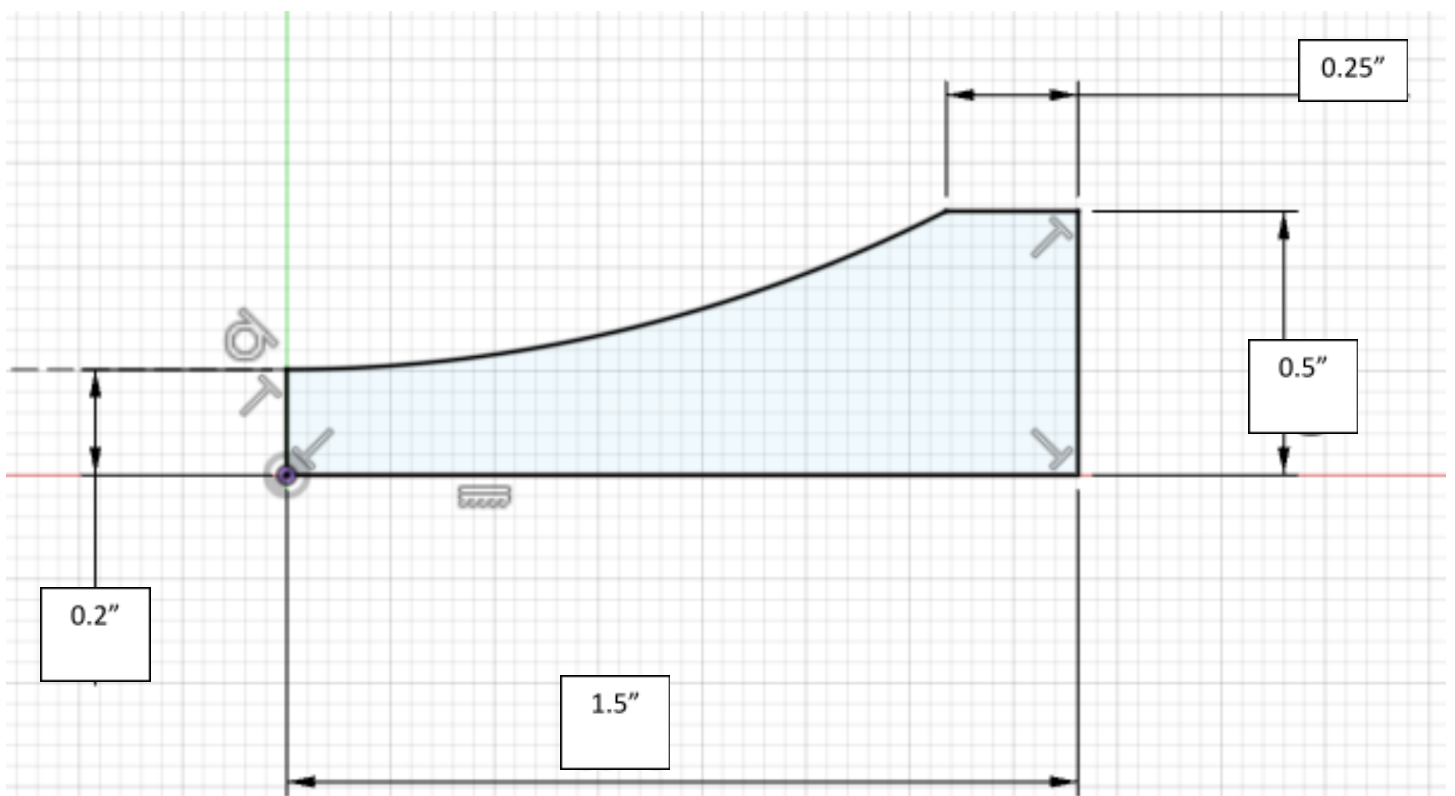
COURSE LAYOUT

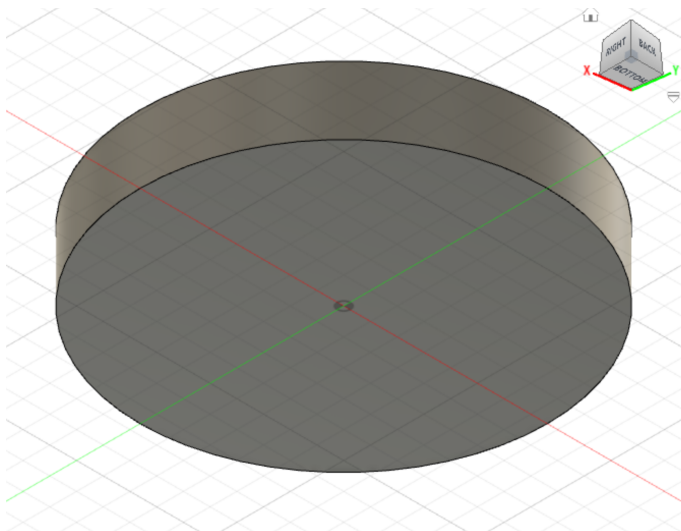
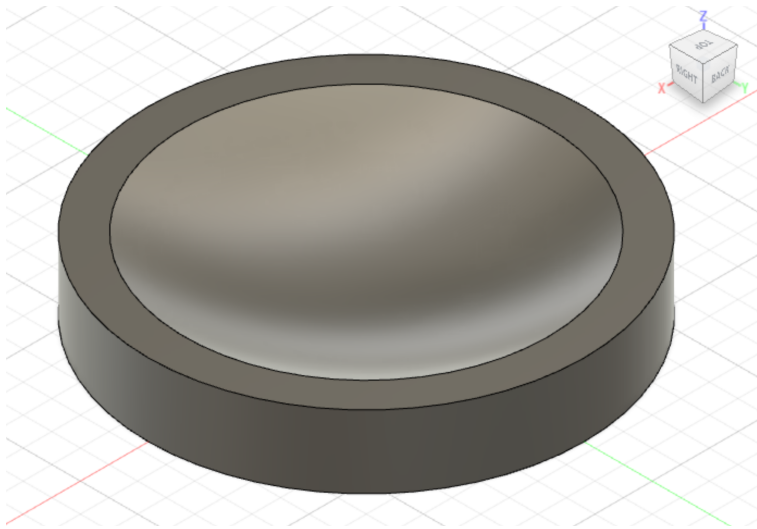
Pilots will fly a course designed with rings/gates on an established pattern with a designated start and finish location. The course layout will not be presented until the day of the event. The team will have ten (10) minutes to fly the course to the finish line. Basic rules:

- The UAS must fly through the ring/gates and NOT through the sides, top or bottom of the lap rings/gates
- First one to release their payload (or in the case of no team successfully completing the event, the team to complete the course the fastest) will proceed to move up in the bracket. Spotters are allowed to place the drone on the floor if it hits a gate or object which will require assistance to resume flight.

BOWL DESIGN

The bowl will be a 3D printed plastic puck 3 inches in diameter and $\frac{1}{2}$ inches tall. There is a $\frac{1}{4}$ inch lip on the sides and the bowl's center point is 0.2 inches off the floor. A schematic and visual is presented below.





COMPLIANCE CHECKLIST

Team Name: _____ School: _____

Your UAS MUST pass all of the compliance checks to compete in the performance events.

Arms are securely attached to frame	<input type="radio"/> Pass	<input type="radio"/> Fail
Propellers are free of cracks	<input type="radio"/> Pass	<input type="radio"/> Fail
Motors are secured to arms	<input type="radio"/> Pass	<input type="radio"/> Fail
Arms and motor mounts are free of cracks	<input type="radio"/> Pass	<input type="radio"/> Fail
Battery is able to securely attach to frame	<input type="radio"/> Pass	<input type="radio"/> Fail
No exposed wiring	<input type="radio"/> Pass	<input type="radio"/> Fail
Max length 190 mm (measured diagonally from motor to motor)	<input type="radio"/> Pass	<input type="radio"/> Fail
Motor guards; full or partial (50%)	<input type="radio"/> Pass	<input type="radio"/> Fail
No greater than 250 grams (~0.55 lbs)	<input type="radio"/> Pass	<input type="radio"/> Fail
10 second hover a few inches from the ground	<input type="radio"/> Pass	<input type="radio"/> Fail
Failsafe check: Land/disarm radio transmitter	<input type="radio"/> Pass	<input type="radio"/> Fail

Note:

If your drone is damaged while racing, it is the Team's responsibility to make repairs or replace parts to ensure it is safe for competition. If you are unsure, present your UAS to the Safety Inspector.

ELEMENTARY AND SECONDARY BRACKET SYSTEM (Fig 1.0; [See Official Challenge Day Brackets the Day of the Event](#))

