



## OVERVIEW

Participants will demonstrate their knowledge of drones and coding by participating in autonomous flight missions. Participants will also study the principles of flight and research the use of drones in a specified topic area. Details about the autonomous flight missions and research topic will be posted on the Washington TSA website ([www.washingtontsa.org](http://www.washingtontsa.org)) under Competitive Events, Washington Only Events. Semifinalists will further demonstrate their drone piloting skills by participating in manual flight missions.

## ELIGIBILITY

- Three (3) teams of two to three (2-3) students per chapter may participate; one (1) entry per team.

## DRONE REGULATIONS

- A. The drone must be programmable and capable of autonomous flight.
- B. The drone (with all components attached) must not exceed the following dimensions:
  - a. 8 in (20 cm) width
  - b. 8 in (20 cm) length
  - c. 5 in (13 cm) height (as measured from the surface the drone is resting upon to the highest point of the drone, with all its components attached)
- C. The drone weight (with all components attached) must not exceed 3.5 oz (100 g).
- D. Propeller guards may be used if, once attached, the overall drone size does not exceed the dimensions listed above.
- E. Only injection molded plastic propellers may be used. All other propellers, (e.g., carbon fiber) are strictly forbidden.
- F. A computer/tablet/smartphone is required to program autonomous flight using MIT Scratch, Python, or applicable apps.
- G. A smartphone/tablet is necessary for manual flight. A gamepad controller may be used for manual flight.
- H. First Person View (FPV) goggles are not allowed.
- I. A list of suggested drones will be posted on the Washington TSA website ([www.washingtontsa.org](http://www.washingtontsa.org)) under Competitive Events, Washington Only Events

## TIME LIMITS

- A. Participants will have 2-1/2 (2:30) minutes to score as many points as possible by completing the missions.
- B. Participants will be given up to two (2) attempts to achieve their best score based on the discretion of the event coordinator.

## ATTIRE

TSA competition attire is required.

## PROCEDURE

### Preliminary Round (Autonomous Flight)

- A. At the event, participants check in their portfolio at the required time and place stated in the conference program, and have their drone inspected.
- B. All participants will be given up to two (2) attempts to score as many points as possible by completing the autonomous flight missions.
  - a. The highest point values will determine the twelve (12) top semifinalists that will fly manually.

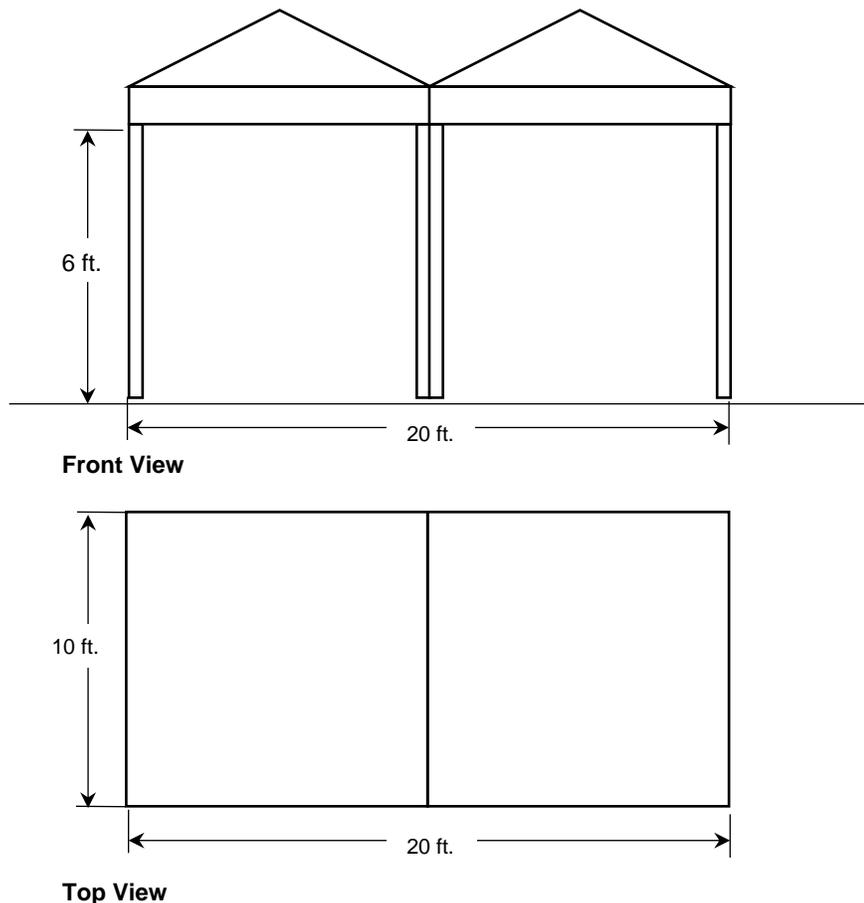
- b. Participants who are disqualified for any reason will not be permitted to participate in the semifinalist round.
- C. Two (2) evaluated areas will be used to determine final standings (see criteria for assessment and performance on the official rating form).
- D. A list of twelve (12) semifinalists will be posted.

**Semifinal Round (Manual Flight)**

- A. The top twelve (12) participants will be given up to two (2) attempts to score as many points as possible by completing the manual flight missions.
- B. Five (5) finalists will be announced during the conference award ceremony.

**THE AIRSPACE**

The airspace consists of two (2) straight leg canopy tents fastened together to form a flying envelope approximately 20 ft. long x 10 ft. wide x 6 ft. high. Netting is hung to isolate the drones from participants and spectators (see Figure 1).



**Figure 1:** Drone Technology Airspace consisting of two (2) 10 ft. x 10 ft. straight leg canopy tents

**SKILL ELEMENTS**

- A. Preliminary Round (Autonomous Flight) missions, mission dimensions, mission locations within the airspace, and mission point values will be posted on the Washington TSA website ([www.washingtontsa.org](http://www.washingtontsa.org)) under Competitive Events, Washington Only Events
- B. Semifinal Round (Manual Flight) missions and mission point values will be revealed on-site.



## **SAFETY**

### **Participant Safety**

- A. Participants are required to provide and wear safety-approved eyewear during all phases of this event.
  - 1. Prescription eye wear will need to have side shields to be considered safety eyewear.
  - 2. Should a participant remove his/her eyewear during the event, s/he will be reminded once to replace it. If there is a second infraction, the participant will be disqualified and asked to leave the competition.
  - 3. Sunglasses or dark tinted safety glasses are not suitable.
- B. Only two (2) participants are allowed in the competition area. One participant will serve as the pilot. The other participant will serve as the spotter. If the team consists of one (1) participant, the participant may act as both the pilot and the spotter.
- C. All participants must remain outside the netted airspace while the drone is flying.
- D. Only one participant will power up and pilot the drone; this includes the gamepad controller, connected smartphone/tablet/computer, and drone.
- E. Participants may only enter the netted airspace to place the drone on the helipad prior to the round countdown or to retrieve a drone that is powered down and has no power to the propellers.

### **Drone Safety**

- A. Power cannot be applied to the propellers unless the drone is in a netted airspace.
- B. Participants may not fly in an intentionally dangerous manner.
- C. Participants may not fly their drone over or near other individuals.
- D. Participants may only fly their drone within the netted airspace.
- E. Participants may only fly their drone when instructed to do so by a judge.
- F. Participants will be asked to crash land or ground their aircraft if its flight course poses a threat to any individuals or goes beyond the boundaries of the netted airspace.
- G. The smartphone/tablet/computer must be placed on the table and remain untouched while a participant is placing the drone on the helipad.
- H. Participants will adhere to all safety rules and directions of event officials.

### **Battery Safety**

- A. Participants may only connect a battery to the drone when the drone is on the “hot table” and told to do so by an event official.
- B. Participants should always be present during the charging of a lithium polymer (LiPo) battery.
- C. Follow good LiPo treatment practices:
  - 1. Do not discharge batteries below 20%.
  - 2. Do not charge batteries above 90%.
  - 3. Never charge a battery that is puffy or punctured.
  - 4. Stop charging immediately if a battery heats up.
- D. Lithium Polymer battery fires are chemical fires that do not require oxygen to burn, so if a battery ignites:
  - 1. Do not pour water on the battery. This will only make the fire worse.
  - 2. Do not place the battery in a sealed container to smother the fire.
  - 3. Do not use a standard household fire extinguisher.
- E. If a battery ignites:
  - 1. Place the battery in a metal bucket of sand, then cover the battery with an additional layer of sand.
  - 2. Place a plastic bag full of sand over the battery.

### **Wireless Network Safety**

- A. Only drones within the netted airspace or “on-deck” at the hot table are to be powered on and connected to a smartphone/tablet/computer. Any team violating this rule is subject to disqualification.



## REGULATIONS

### Preliminary Round - Documentation

- A. Documentation materials (comprising a "portfolio") are required and should be placed and secured in a clear front report cover. (Click [here](#) for a sample.)
- B. The report cover must include the following single-sided, 8½" x 11" pages, in this order:
  1. Title page with the event title, conference city and state, the year, and the team/chapter ID number; one (1) page
  2. Table of contents; one (1) page
  3. Solution to Competition Theme Problem, including competition problem statement, drone research and solution description; two (2) pages
  4. Flight Plan – graphical representation of planned autonomous mission flight paths (template on the Washington TSA website ([www.oktsa.org](http://www.oktsa.org)) under Competitive Event Information); one (1) page
  5. Autonomous Program(s) - printouts of autonomous program coding; pages as needed
  6. Sections of the portfolio may be organized by dividers.

### Preliminary Round (Autonomous Flight)

- A. This round utilizes the drone's autonomous flight capability. Using Scratch, Python, or applicable apps, participants will code their drone to navigate various missions autonomously.
- B. The round lasts 2-1/2 (2:30) minutes, and the timer never pauses.
- C. Various points will be assigned for each mission accomplished.
- D. The missions, mission dimensions, mission locations within the netted airspace, and mission point values will be posted on the Washington TSA website ([www.washingtontsa.org](http://www.washingtontsa.org)) under Competitive Event Information.
- E. The autonomous program specifications are as follows:
  - a. Missions do not need to be navigated in any specific order. Points are awarded based on successfully navigating individual missions.
  - b. Navigating through missions can be done collectively with a single autonomous program or individually with multiple mission programs, or any combination in-between.
  - c. If using multiple flights, the drone must return to the landing zone and powered down, having no power to the propellers. A participant may enter the netted airspace, pick up the drone, and move it back to the helipad for an additional flight.
  - d. For safety, "emergency landing" code must be included that causes the drone to land immediately and/or stops all power to the propellers.
  - e. No changes may be made to the autonomous programs during the round.
- F. The round specifications are as follows:
  1. Only one (1) team will be allowed in the competition area.
  2. A "hot table" will be set up for a team to power up the drone, connect to the computer/tablet/smartphone, and load the autonomous program(s) just prior to the flight.
    - a. Only a team that is "on deck" to fly should be at the hot table.
    - b. Teams may have spare parts (e.g., propellers, batteries) available, but must supply their own parts.
  3. At flight time, the drone will be placed on the helipad (2 ft. x 2 ft. square) within the landing zone (3 ft. x 3 ft.) of the netted airspace.
    - a. The team may place their drone control system (smartphone/tablet/computer) on the table in the pilot area.
    - b. Power cannot be applied to the propellers until the round begins.
    - c. The round will begin with a countdown ("3, 2, 1, Go"). At that time, the pilot may start the autonomous program.
    - d. The drone must be in contact with the helipad when the word "go" is announced. Takeoff before the official start will result in a Did Not Fly (DNF) for the round.
  4. Only one (1) team member will be allowed in the pilot area. This team member will serve as the pilot and will start the autonomous program(s).
    - a. No autonomous programs may be started until all persons are out of the netted airspace.



5. A second team member will serve as the spotter.
  - a. The spotter must remain outside the netted airspace while power is applied to the drone propellers.
  - b. If using multiple flights, the spotter may enter the netted airspace, pick up the drone from within the landing zone, and move it back to the helipad for an additional flight.
  - c. If the drone unintentionally stops outside the landing zone during the round and no power is applied to the drone propellers, the spotter may enter the netted airspace, pick up the drone, and move it back to the helipad for an additional flight.
  - d. If the drone is handled outside the landing zone, there will be a penalty.
  - e. If a part of the drone becomes detached during the round, it may be retrieved after the round is scored and there is no penalty. If a team member retrieves the detached part during the round, there will be a penalty.
  - f. The spotter may make repairs or switch batteries if the drone is within the landing zone.
  - g. The spotter may not touch any part of the missions. A violation of this rule will result in disqualification of the offending team.
6. If the team consists of one (1) participant, the participant may act as both the pilot and the spotter.
7. Participants will not be penalized for accidental contact with mission and/or airspace elements.
8. Intentional damage to missions will result in disqualification of the offending team.
9. At the end of the round, everything must be preserved exactly as-is.
  - a. If the drone is moving, it must be landed, and the propellers powered down.
  - b. The drone must be left in place.
  - c. Missions completed after the end of the round will not be scored.
10. The judge will discuss what happened with the team, mission by mission.
  - a. If the participants agree with everything on the scoresheet, they sign the sheet, and the score is final.
  - b. Any challenges must be made at this time and come from participants who are actively competing, not the advisor, parent, or coordinator.
  - c. If the participants do not agree with something, the lead judge will make the final decision.
11. Only competing participants and event officials may be in the event area.
  - a. All other spectators, including coaches/advisors, parents, coordinators, and non-competing students, must remain in the designated spectator area throughout the duration of the round.
  - b. Participants will be disqualified if a spectator, including a coach/advisor or parent, interferes with a flight. This includes a coach/advisor or parent helping participants with their autonomous program(s).
12. Participants will be given up to two (2) attempts to achieve their best score based on the discretion of the event coordinator.
13. Judges may inspect the drone and/or autonomous programs at any time before, during, and after the preliminary round.
14. Any additional rules, regulations, or guidelines established by the event coordinator must be followed.

### **Semifinal Round (Manual Flight)**

- A. This round challenges participants' flying skills as they manually pilot their drone through various missions.
- B. The round lasts 2-1/2 (2:30) minutes, and the timer never pauses.
- C. Various points will be assigned for each mission accomplished.
- D. The missions, mission dimensions, mission locations within the netted airspace, and mission point values will be revealed on-site the day of the competition.
- E. The round specifications are as follows:
  1. Only one (1) team will be allowed in the competition area.
  2. A "hot table" will be set up for a team to power up the drone and connect to the smartphone/tablet.
    - a. Only a team that is "on deck" to fly should be at the hot table.
    - b. Teams may have spare parts (e.g., propellers, batteries) available, but must supply their own parts.



3. At flight time, the drone will be placed on the helipad (2 ft. x 2 ft. square) within the landing zone (3 ft. x 3 ft.) of the netted airspace.
  - a. The smartphone/tablet and/or gamepad controller must be placed on the table and remain untouched while a team member is placing the drone on the helipad.
  - b. Power cannot be applied to the propellers until the round begins.
  - c. The round will begin with a countdown (“3, 2, 1, Go”). At that time, the drone may takeoff.
  - d. The drone must be in contact with the helipad when the word “go” is announced. Takeoff before the official start will result in a Did Not Fly (DNF) for the round.
4. Only one (1) team member will be allowed in the pilot area. This team member will serve as the pilot.
  - a. The pilot may only control the drone from within the pilot area.
5. A second team member will serve as the spotter.
  - a. The spotter must remain outside the netted airspace while power is applied to the drone propellers.
  - b. If the drone unintentionally stops outside the landing zone during the round and no power is applied to the drone propellers, the spotter may enter the netted airspace, pick up the drone, and move it back to the helipad for an additional flight.
  - c. If the drone is handled outside the landing zone, there will be a penalty.
  - d. If a part of the drone becomes detached during the round, it may be retrieved after the round is scored and there is no penalty. If a team member retrieves the detached part during the round, there will be a penalty.
  - e. The spotter may make repairs or switch batteries if the drone is within the landing zone.
  - f. The spotter may not touch any part of the missions. A violation of this rule will result in disqualification of the offending team.
6. If the team consists of one (1) participant, the participant may act as both the pilot and the spotter.
7. If the team consists of two (2) participants, the pilot and spotter may switch roles at any time, but only one (1) team member will be allowed in the pilot area.
8. Missions do not need to be navigated in any specific order. Points are awarded based on successfully navigating individual missions.
9. Participants will not be penalized for accidental contact with mission and/or airspace elements.
10. Intentional damage to missions will result in disqualification of the offending team.
11. Participants will be asked to crash land or ground their aircraft if its flight course poses a threat to any individuals or goes beyond the boundaries of the netted airspace.
12. Drones that fly outside the netted airspace will be disqualified.
13. At the end of the round, everything must be preserved exactly as-is.
  - a. If the drone is moving, it must be landed, and the propellers powered down.
  - b. The drone must be left in place.
  - c. Missions completed after the end of the round will not be scored.
14. The judge will discuss what happened with the participants, mission by mission.
  - a. If the participants agree with everything on the scoresheet, they sign the sheet, and the score is final.
  - b. Any challenges must be made at this time and come from participants who are actively competing, not the advisor, parent, or coordinator.
  - c. If the participants do not agree with something, the lead judge will make the final decision.
15. Only competing participants and event officials may be in the event area.
  - a. All other spectators, including coaches/advisors, parents, coordinators, and non-competing students, must remain in the designated spectator area throughout the duration of the round.
  - b. Participants will be disqualified if a spectator, including a coach/advisor or parent, interferes with a flight.
16. Participants will be given up to two (2) attempts to achieve their best score based on the discretion of the event coordinator.
17. Judges may inspect the drone and/or drone control systems at any time before, during, and after the semifinalist rounds.
18. Any additional rules, regulations, or guidelines established by the event coordinator must be followed.



## **EVALUATION**

Preliminary evaluation is based on:

1. The documentation portfolio
2. The autonomous missions score

Semifinal evaluation is based on:

1. The manual flight missions score
2. Team interview

Refer to the official rating form for more information.



Participant/Team ID# \_\_\_\_\_

# Drone Technology (Washington ONLY)

2022 OFFICIAL RATING FORM

HIGH SCHOOL

## Go/No Go Specifications

Before judging an entry, ensure all items below are present; indicate presence with an "X" in the box. If an item is missing, leave the box blank.

- Portfolio is present
- The drone meets all required specifications
- Safety glasses are worn by all team members
- Flight Plan is present
- Drone Wi-Fi Network Name is present

## Criterion Performance Levels

CRITERIA	Minimal performance 1-4 points	Adequate performance 5-8 points	Exemplary performance 9-10 points
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Evaluators: Using minimal (1-4 points), adequate (5-8 points), or exemplary (9-10 points) performance levels as a guideline, record the scores earned for the event criteria in the column spaces to the right. The X1 or X2 notation in the criteria column is a multiplier factor for determining the points earned. (Example: an "adequate" score of 7 for an X1 criterion = 7 points; an "adequate" score of 7 for an X2 criterion = 14 points.) A score of zero (0) is acceptable if the minimal performance for any criterion is not met.

## Documentation (40 points)

<b>Competition Theme Solution</b> (X1)	An explanation of the problem and the solution is poorly presented. There is little or no evidence of understanding drone capabilities.	The solution is somewhat original, mostly developed, and generally solves the problem(s). There is some evidence of research and understanding of drone capabilities and use.	The solution is highly original, fully developed, and clearly solves the identified problem(s). There is solid evidence of research and understanding of drone capabilities and use.
<b>Competition Theme Research</b> (X1)	The research is inadequate, and/or very few credible sources are referenced.	The research is adequate, and it includes a few credible sources.	The research is comprehensive, and credible resources are included.
<b>Flight Plan</b> (X1)	Graphic flight plan is missing, and/or unclear, and/or advisor signature or drone wi-fi network name not included.	Graphic flight plan is mostly clear, mission sequence is evident, and generally complete.	Mission sequence is clearly understood and complete with a thorough understanding of a graphic flight plan's purpose as a flight aid.
<b>Autonomous Program(s)</b> (X1)	Printout of autonomous code is missing, and/or incomplete. The coding is not fluid and/or is illogical.	A beyond-basic degree of technical skill is exhibited in the coding. The coding is somewhat organized, and some comments are present.	The coding exhibits mastery of proper coding practices; the organization is logical and well documented.

**DOCUMENTATION SUBTOTAL (40 points)**

## Autonomous Flight (60 points)

### Autonomous Flight Missions

Best score point total will be transferred from the team scoresheet. (Mission point values will be posted on the Washington TSA website ([www.washingtontsa.org](http://www.washingtontsa.org)) under Competitive Event Information)

**AUTONOMOUS FLIGHT SUBTOTAL (60 points)**

**Rules violations** (a deduction of 20% of the total possible points for the above sections) must be initialed by the evaluator, coordinator and manager of the event. Record the deduction in the space to the right.

Indicate the rule violated: \_\_\_\_\_

**PRELIMINARY SUBTOTAL (100 points)**

Record scores in the column spaces below.

Semifinal Round			
Manual Flight (50 points)			
<b>Manual Flight Missions</b> Best score point total will be transferred from the team scoresheet. (Mission point values will be revealed on-site the day of the competition.)			
<b>MANUAL FLIGHT SUBTOTAL (50 points)</b>			
Team Interview(15 points)			
CRITERIA	Minimal performance 1-5 points	Adequate performance 6-10	Exemplary performance 11-15
<b>Team Interview</b> (10% of the total event points)	The team's efforts are not clearly communicated, lack detail, and are unconvincing; only one team member speaks, little teamwork is evident.	The team's efforts are adequately communicated, include some detail, are clear, and are generally convincing; more than one team member is involved in discussion, evidence of teamwork	The team's efforts are clearly communicated, fully-detailed, and convincing; all members of team are actively participating, subject matter knowledge is excellent.
<b>SEMIFINAL INTERVIEW SUBTOTAL (15 points)</b>			
<b>Rules violations</b> (a deduction of 20% of the total possible points for the above sections) must be initialed by the evaluator, coordinator and manager of the event. Record the deduction in the space to the right.  Indicate the rule violated: _____			
<b>SEMIFINAL SUBTOTAL (65 points)</b>			
(To arrive at the TOTAL score, add the PRELIMINARY SUBTOTAL and the SEMIFINAL SUBTOTAL.)			<b>TOTAL (165 points)</b>
Comments:			
I certify these results to be true and accurate to the best of my knowledge.			
<u>Judge</u>			
Printed name: _____		Signature: _____	