

# DRONE CHALLENGE (UAV)



## OVERVIEW

Applying leadership and 21<sup>st</sup> century skills, participants design, build, assemble, document and test fly an open-source Unmanned Aerial Vehicle according to stated specifications and to meet the challenge of the yearly theme/problem.

The annual theme will be posted on the [TSA website](#) under *Themes & Problems*.

## ELIGIBILITY

Teams of two (2) to six (6) members. Three (3) teams per state.

## TIME LIMITS

- A. Ten (10) minutes prior to assigned times teams can set up their assigned pit area.
- B. Thirty (30) minutes session to test and correct any problems. During this time judges will also perform a safety check.
- C. Ten (10) minutes to complete the challenge.
- D. Five (5) minutes for the semifinalist interview.

## ATTIRE

TSA competition attire is required for this event.

## PROCEDURE

### PRE-CONFERENCE

- A. Participants access the annual theme on the [TSA website](#) under *Themes & Problems*.
- B. Participants prepare their documentation and design, build, and test their UAV drone

### PRELIMINARY ROUND

- A. Participants will sign up for a setup and testing time at the time and place stated in the conference program and submit their portfolios.
- B. Students will arrive at the assigned place and time to:
  - 1. Set up their pit areas
  - 2. Set up their drone

- C. Entries are reviewed by judges to determine safety.
- D. Safe drones will be given opportunity to test.
- E. Top sixteen (16) scores on drone testing will have their portfolios evaluated.
- F. A list of twelve (12) semifinalists (in random order) is posted.

### SEMINFINAL ROUND

- A. Participants report at the time and place stated in the conference program to sign up for an interview time.
- B. Participants report at the assigned time and place for the five (5) minutes interview
- C. Portfolio, challenge, and interviews scores are combined with race points to determine the final standings.
- D. The top ten (10) finalists are announced at the awards ceremony.

## REGULATIONS AND REQUIREMENTS

Students will work to develop their leadership and 21<sup>st</sup> century skills in the process of preparing for and participating in this TSA competitive event. The development and application of those skills must be evident in their submission, demonstration, and/or communication pertaining to the entry.

### PRELIMINARY ROUND

- A. Participants must check for the current year's design challenge specifications on the [TSA website](#) under *Themes & Problems*.
- B. Documentation Portfolio:
  - 1. Documentation materials (comprising "a portfolio") are required and must be submitted as a multi-page PDF document on a USB flash drive with pages in this order:
    - a. Title page with the name of the event, the event title, the conference city and state, the year; and the team identification number; one (1) page
    - b. Table of Contents; one (1) page

- c. Photo log of major steps in the production and assembly of the drone. From motors to frame mount to final flight ready UAV Drone. Showing all step of the mounting electronic speed controllers, video transmitters, flight controllers, video transmitters, flight controllers, cameras, antennas, etc., all being mounted and wired. Include captions describing the steps; pages as needed
  - d. Wiring schematic drawings of their UAV Drone components (modules) in their portfolio binder with associated wiring of component to components. Identified voltages would be an advantage; pages as needed
  - e. Explanation of Programming software for flight functioning and stabilization. (i.e., Q-Ground Control, Beta flight, etc.). Plus, any additional software and hardware used for mission function (robotic software, microcontroller software for Arduinos, raspberry pi, etc.); pages as needed
  - f. Engineered drawings of assembled UAV and all manufactured and modified parts. Drawings must be shown on a maximum sheet cut size B(11"x17"), with the appropriate scale noted on the drawing; maximum of four (4) pages
  - g. Document all parts and components of the open source UAV Drone as a bill of materials spreadsheet; two (2) pages
  - h. Research of rules and regulations for drone flight at the national conference location. Local, regional, and federal regulations must be included; two (2) pages.
  - i. Resources; pages as needed
  - j. Plan of Work Log; pages as needed
  - k. Student Copyright checklist
- 1. Teams are required to bring two welding blankets (4' x 6' minimum) to cover the table and floor in their pit area.
  - 2. Teams bring to pit area, for inspection, primary UAV Drone and a backup UAV Drone, radio controller(s), chargers, batteries, tools box, power strip, 3-prong electrical extension cord, replacement parts, spare parts and tools
  - 3. All necessary computers and associated software for the competition.
  - 4. All equipment, portfolio, tools, chargers, and computers are to be arranged for inspection and safety check. The use of tools with combustible fuel sources is prohibited.
  - 5. In the pit area, battery chargers and batteries, as they are being charged, must be placed on the fireproof welding blanket in the pits charging area.
- B. When UAV Drone is out of the competition tent area, all propellers must be removed. NO EXCEPTIONS.
  - C. When a team member enters the competition tent field, only at the direction of the event coordinator may the team members attach the battery cable and turn on their UAV Drone and become ready to fly. When A UAV Drone is outside of the competition tent area, all batteries must be unplugged from the UAV Drone stack, which should consist of the flight controller receiver and the Electronic Speed Controller (ESE). NO EXCEPTIONS.
  - D. The judge will inspect the UAV Drone mounted propellers to ensure safe operation.
  - E. When the competition is taking place and when a practice session is under way with a UAV Drone in the competition field area flying, all UAV Drone in the pit area or outside the pit area must be POWERED OFF. This is an automatic ten (10) Point deduction if this occurs.
  - F. All batteries will be inspected prior to flight practice and the competition.
  - G. All UAV Drones must fly ONLY with the Competition field.

### **UAV Drone Challenge Pit and Safety procedures**

- A. Pit Area Assignment. The Event Coordinator will provide a designated area for UAV Drone Teams to work on and prepare their UAV Drone for flight.

**UAV Drone Specifications**

- A. Competing Unmanned Aerial Vehicles UAV Drone MUST HAVE four motors and four propeller blades.
- B. UAV Drone must be assembled from open-sourced parts. The UAV Drone can be purchased as a kit that can be built, reconfigured, changed, and modified with different components.
- C. The UAV Drone frame structure can be made from plastic, wood, 3D printed materials (carbon fiber, PLA plastic, ABS plastic, resin, metal combined plastic or resin). Parts can be purchased commercially and modified. NO COMMERCIALY AVAILABLE DRONE WILL BE USED IN THE COMPETITION (i.e., Mavic Pro or Mavic Mini) OR PRACTICE SESSIONS.
- D. Battery packs must only be commercially available lithium-ion batteries that are purchased from open-sourced 3rd parties (i.e., Amazon, hobby shops, etc.).
- E. Drone Regulations
  1. The UAV Drone propellers can be in size from 4" (101mm) to 8" (152.4mm) in overall length.
  2. Sizes can be from 6" (152.4mm) to 14" (355.6mm) in outside motor propeller size diagonally.
  3. The UAV Drone can optionally use propeller guards [but must fit inside a 18" x 18" (457.2mm x 457.2mm) go-no-go box for pre-flight inspections by the judges.]
  4. Drone must include incorporate the use of Magnets or Grippers to complete the theme for the year.
  5. Drone propellers must be removable for inspection.
  6. Landing gear should be adjustable or adaptable in size to cover a variety of mission requirements and payload sizes.
  7. A camera for the pilot is also required to be mounted to the drone.

**EVALUATION****PRELIMINARY ROUND****Tier 1**

- A. Drone Testing

**Tier 2**

- B. Portfolio

**SEMINFINAL ROUND**

- A. The interview

Refer to the official rating form for more information.

**STEM INTEGRATION**

This event aligns with the STEM (Science, Technology, Engineering, and Mathematics) educational standards.

**LEADERSHIP AND 21<sup>ST</sup> CENTURY SKILLS DEVELOPMENT**

This event provides opportunity for students to build and develop leadership and 21<sup>st</sup> century skills including but not limited to:

- Communication
- Collaboration/Social Skills
- Initiative
- Problem Solving/Risk Taking
- Critical Thinking
- Perseverance/Grit
- Creativity
- Relationship Building/Teamwork
- Dependability/Integrity
- Flexibility/Adaptability

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## 2023 & 2024 OFFICIAL RATING FORM HIGH SCHOOL

Judges: Using minimal (1-4 points), adequate (5-8 points), or exemplary (9-10 points) performance levels as a guideline in the rating form, 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.

### Go/No Go Specifications

- Before judging the entry, ensure that the items below are present; indicate presence with a check mark in the box.
- If an item is missing, leave the box next to the item blank and place a check mark in the box labeled ENTRY NOT EVALUATED.
- If a check mark is placed in the ENTRY NOT EVALUATED box, the entry is not to be judged.

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- TIER 1 – Drone/Welding Blankets
  - TIER 2 – USB Portfolio
  - ENTRY NOT EVALUATED

TIER 1 – TESTING OF DRONE (60 points)					
Evaluation: Completion of predetermined challenge is used to determine ranking. Time that the challenge is completed in is used to break ties.					
1st: 60 Points	2nd: 55 Points	3rd: 50 Points	4th: 45 Points	5th: 40 Points	6th: 35 Points
7th: 30 Points	8th: 25 Points	9th: 20 Points	10th: 15 Points	11th: 10 Points	12th-16th: 5 Points
<b>TIER 1 – TESTING OF DRONE SUBTOTAL (60 points)</b>					

Rules violations (a deduction of 20% of the total possible points for the above sections) must be initialed by the judge, coordinator, and manager of the event. Record the deduction in the space to the right.
Indicate the rule violated: _____

TIER 2 – PORTFOLIO (80 points)			
CRITERIA	Minimal performance	Adequate performance	Exemplary performance
	1-4 points	5-8 points	9-10 points
<b>Portfolio Components</b> (X1)	The portfolio is unorganized and three (3) or more components or sections are missing.	The portfolio is generally well organized and may be missing only one (1) or two (2) components or sections.	The portfolio is exceptionally well organized and contains all required components or sections.
<b>Photo Log</b> (X1)	There are little photos of the drone construction/components installation are not included and/or captions are not present on any of the photos.	Most photos of the drone assembly/testing are included and most captions are present.	All photos of the drone assembly/testing are included and captions are present.
<b>Wiring Diagram</b> (X1)	The wiring diagrams are not complete and/or many of the elements missing.	The wiring diagrams are present but may be missing several key components and detailing	All wiring diagrams are complete and correct, with all components and detailing.

Record scores in the column spaces below.

<b>TIER 2 – PORTFOLIO (80 points) – continued</b>				
<b>Programming Explanation/Description</b> (X1)	The explanation /description is unorganized and three (3) or more details or descriptions are missing.	The explanation /description is generally well organized and may be missing only one (1) or two (2) details or descriptions	The explanation /description is exceptionally well organized and contains all required details and descriptions	
<b>Engineered Drawings</b> (X1)	The engineered drawings are not complete, with many of the required elements missing.	The engineered drawings are present but may be missing several required key components and detailing	All engineered drawings are complete and correct, with all components and detailing.	
<b>Bill of Materials</b> (X1)	Bill of Materials is included, but more than three (3) materials are missing.	A Bill of Materials is included, with one (1) or two (2) materials missing; Bill of Materials is generally organized.	All components of the Bill of Materials is included and highly organized.	
<b>Drone Flight Regulations</b> (X1)	The report is unorganized and three (3) or more details about drone flight regulations are missing.	Report is generally well organized and may be missing one (1) or two (2) details about information about local, regional, and federal drone flight regulations.	Report is well organized and contains information about local, regional, and federal drone flight regulations.	
<b>Plan of Work Log</b> (X1)	The Plan of Work log is not complete.	The Plan of Work log is included and mostly complete.	The Plan of Work log is complete and fully documents project work.	
<b>TIER 2 – PORTFOLIO SUBTOTAL (80 points)</b>				

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

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

<b>SEMIFINAL INTERVIEW (40 points)</b>				Record scores in the column spaces below.
<b>CRITERIA</b>	Minimal performance	Adequate performance	Exemplary performance	
	1-4 points	5-8 points	9-10 points	
<b>Knowledge</b> (X2)	Participants seem to have little understanding of the concepts in their project; answers to questions may be vague.	Participants exhibit a general understanding of the concepts in their project.	Participants show clear evidence of a thorough understanding of the concepts in their project.	
<b>Articulation</b> (X1)	Communication of the project is unclear, unorganized, and or illogical; leadership and/or 21st century skills are not evident.	Communication of the project is somewhat logical and clear; leadership and/or 21st century skills are somewhat evident.	Communication of the project is clear, concise, and logical; leadership and/or 21st century skills are clearly evident.	
<b>Team Participation</b> (X1)	The majority of the delivery is made by one (1) member of the team; the partners may be disengaged from the Interview	Team members are generally engaged in the process, though one member may take on more responsibility than the others.	Team members are actively involved in the Interview and responses to interview questions; there is shared responsibility on the part of team members.	
<b>SEMIFINAL INTERVIEW SUBTOTAL (40 points)</b>				

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

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

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To arrive at the TOTAL score, add any subtotals and subtract rules violation points, as necessary.

**TOTAL (180 points)**

Comments:

I certify these results to be true and accurate to the best of my knowledge.

**JUDGE**

Printed name: \_\_\_\_\_ Signature: \_\_\_\_\_

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## EVENT COORDINATOR INSTRUCTIONS

### PERSONNEL

- A. Event coordinator
- B. Judges, two (2) or more
- C. Pit Area Judge/Inspector (1)
- D. Assistants, two (2)

### MATERIALS

- A. Coordinator's packet and box, containing:
  - 1. Event guidelines, one (1) copy for the coordinator and for each judge
  - 2. TSA Event Coordinator Report
  - 3. List of judges/assistants
  - 4. Time trial record sheet
  - 5. Qualifier interview time slot sheet
  - 6. Stick-on labels for entries, as needed
  - 7. Results envelope
- B. Testing Arena – two (2) 10' x 10' tents frame only. Covered with bird netting.
- C. Course materials based on theme
- D. Table with power for the Pit Area for the competitors
- E. Table for inspection and tabulation
- F. 2-Step ladder with platform for judging and setup
- G. Provide for a display trial times

### RESPONSIBILITIES

#### AT THE CONFERENCE

- A. Attend the mandatory coordinator's meeting at the designated time and location.
- B. Report to the CRC room and check the contents of the coordinator's packet.
- C. Review the event guidelines and check to see that enough personnel have been scheduled.
- D. Inspect the area(s) in which the event is to be held for appropriate set-up, including room size, tables, chairs, etc. Notify the event manager of any potential problems.
- E. At least one (1) hour before the event is to begin, meet with judges and assistants to review time limits, procedures, regulations, evaluation, and all other details related to the event. If questions arise that cannot be answered, speak to the event manager before the event begins.

### EVENT CHECK-IN

- A. Participants report to the time and place stated in the conference program and check in:
  - 1. Portfolio
  - 2. Sign up for setup/testing time
- B. Late entries are considered on a case-by-case basis and only when the lateness is caused by events beyond the participant's control.
- C. In order to compete, participants must be on the entry list or must have approval of the CRC.
- D. Requirements for attire do NOT apply during check-in, only on the first day of the conference.
- E. Check to see that flash drive has the participant's team identification.
- F. Secure the entries in the designated area.

### PRELIMINARY ROUND

- A. Assist judges with the check in/setup of pit area.
- B. Assist judges with the drone portion of the event and then the judging of the portfolios of the top sixteen (16) entries following the drone portion.
- C. Decisions about rules violations must be discussed and verified with the judges, event coordinator, and CRC manager to determine either:
  - 1. To deduct twenty percent (20%) of the total possible points in this round or
  - 2. To disqualify the entry
 The event coordinator, judges, and CRC manager must initial either of these actions on the rating form.

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- D. Begin the time trials at the scheduled time.
  - 1. Every Drone that is compliant with rules should have the opportunity to be tested.
  - 2. Public viewing is allowed.
  - 3. Announce starting time stop if there is an issue teams do not get additional testing time if they need to complete a repair of adjustment.
- E. Position a judge on either side of the testing area to view the trial.
- F. If a time is not properly recorded, a rerun may be ordered at the discretion of the event coordinator.
- G. Record preliminary times on a time trial record sheet.
- H. Review the top trial scores and use fastest times to break any times and submit the top sixteen (16) results.
- I. Evaluate the top sixteen (16) trials portfolios.
- J. Submit the top twelve (12) finalist to the CRC room to post for a semifinalist interview.

### SEMIFINAL ROUND

- A. Post the top twelve (12) teams with interviews times.
- B. Drone builders report to the designated area posted time for a five (5)-minute Drone Team interview.
- C. Conduct interviews with the qualifying top twelve (12) Drone Teams.
- D. Begin the semifinals at the scheduled time.
- E. Discuss rule violations (e.g. 20% deduction, disqualification) and have all relevant parties initial the rating form.
- F. Judges use qualifying times to break any ties among the twelve (12) qualifying drones
- G. Submit the finalist results and all related forms in the results envelope to the CRC room.
- H. If necessary, manage the security and removal of materials from the event area.