Commercial sUAS Drone

Purpose: To evaluate each contestant's preparation for employment in multiple career fields related to the safe and efficient use of drone technology in the National Airspace System (NAS) and to recognize outstanding performance by participants in real-world, scenario-based situations.

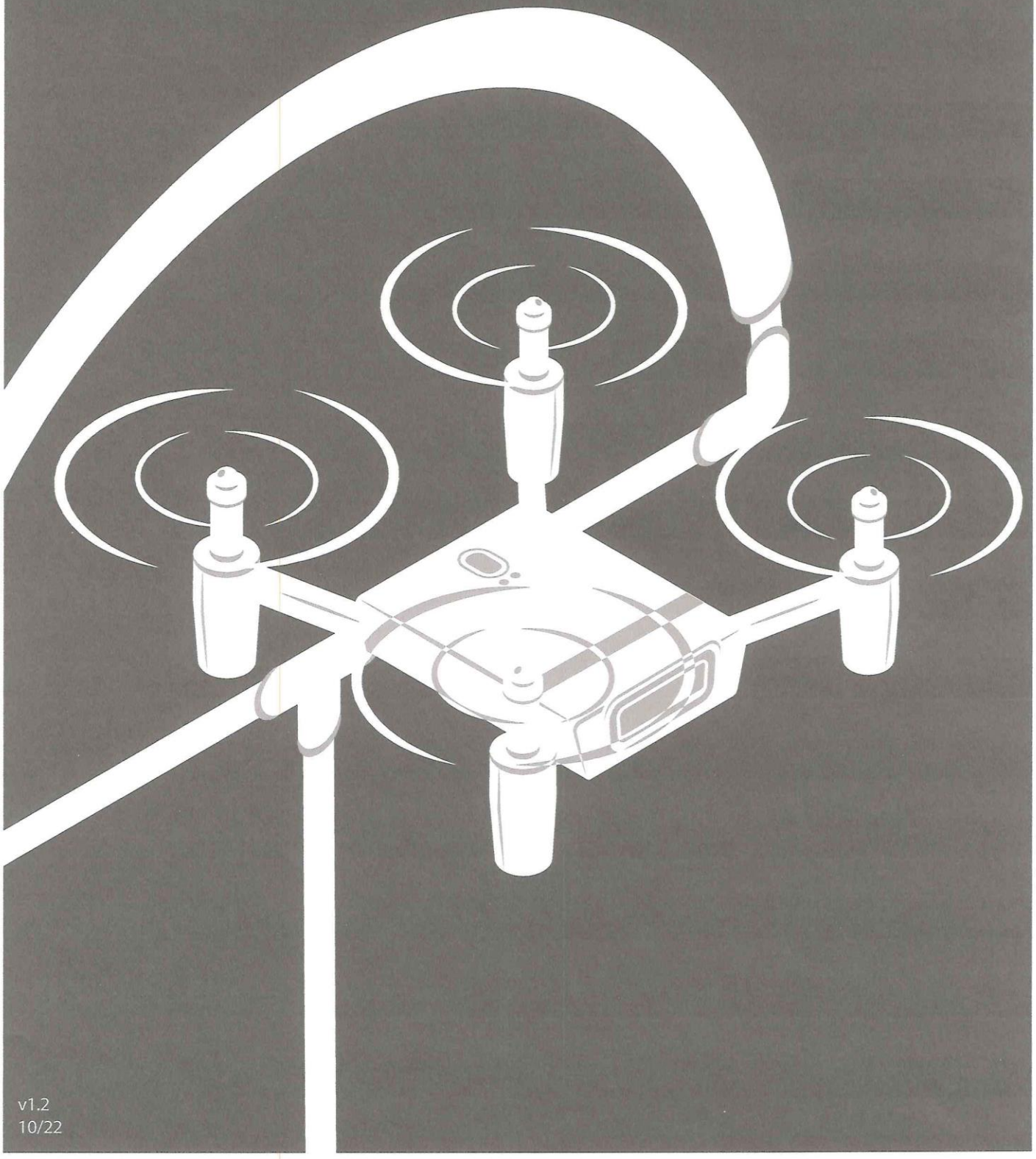
Contest Location	▪ A-Hall
Eligibility	▪ Team of two (2). One Remote Pilot (RP) and one Visual observer (VO) ▪ One team (1) per school
Clothing	Work/School Attire: School uniform with all identifying logos/markers covered. Field specific work clothing required for the work environment or that matches the service conditions for the contest. This may include jeans if they are clean and professional looking and are accepted in the respective field (no holes or overly soiled pants). Work shoes or boots with hard sole or anti-slip properties (steel toes may be required-refer to **Provided by Contestant** section below). Clothing should be as such that it will not get caught in moving equipment or power tools. School uniforms may be worn if they meet the above requirements with all identifiers covered. **Safety glasses with side shields or goggles (Prescription glasses can be used only if they are equipped with side shields. If not, they must be covered with goggles).
Testing	▪ Series of Psycho Motor Skills testing, oral interview, a written FAA exam, and a Maintenance/Troubleshooting exam will be part of the contest. ▪ Students should also be prepared to take a SkillsUSA written knowledge test (Required for all contestants prior to contest day).
Provided by Contestant **(Tool List)**	Contestant Teams are **NOT AUTHORIZED** to share equipment with other teams. ▪ Laptop ▪ Fully assembled, tested, and operational drone with onboard camera. Capable of recording images either through a Miros SD

	card, hard drive in the drone or through the monitor/controller. Drone must be capable of operating inside the Convention Center. □ Done must be capable, with prop guards or cages attached, of passing through a possible obstacle 20 inches high x 29 inches wide and landing in 12-inch landing pad. ▪ REQUIRED – Prop Guards or Prop Cages to protect the propellers and all persons in the area while operating inside. ▪ Strobe light that can mount on the drone. ▪ Controller ▪ Monitor or tablet (no internet hookup will be permitted) ▪ Extra access, props, cables, extra batteries. ▪ Carrying case ▪ NOTE: One of the scenarios the pilot may have to use the drone to dislodge an item. Therefore, a bumper or push bar mounted on the drone, extending out from the front of the drone will be needed. A 3D printed bumper or push bar attached to the drone will be acceptable for use in the competition. ▪ Pilot Logbook. Flights will need to be logged just like a real mission/operation would be. ▪ Eye Protection (safety glasses/goggles of some sort or prescription glasses)
Special Notes	▪ Contest will begin as soon as orientation has been completed. ▪ **Contest will be closed to observers and advisors.** ▪ Contestants arriving after 10:00 a.m. will result in an automatic disqualification. ▪ Each contestant will be given a checklist of workstations. ▪ Each contestant will rotate through and complete each scenario/workstation. ▪ Each contestant will be scored by each individual workstation judge(s). ▪ If the workstation requires photographs to be taken by the drone, data must be either on a Micro SD card or hard drive in the drone or controller/monitor/tablet. The Micro SD card or drone, controller/monitor/tablet will be made available for downloading of the photographs.

	▪ Failure to bring required equipment will result in a reduction in scoring.

	▪ No smart watches, phones, or earbuds are permitted during the contest and/or in contest. ▪ No contact with anyone outside of the contest area once the contest begins. ▪ No inappropriate communication between contestants such as verbally degrading another contestant. ▪ No cheating on any portion of the contest such as informing another contestant of the skills/test prior to competing.
National Technical Standard	▪ Please refer to the 2022-2023 National Technical Standards for all contests. Any and all standards included may be tested in any competition. ▪ In conjunction with National Standards, violations may result in student loss of contest
Resume	▪ All contestants must have a hard copy of a one (1) page personal resume. ▪ All SkillsUSA Ohio State Championship Contest will require a short interview component. Students should be prepared with basic job interview skills.

If you're interested in holding or participating in a SkillsUSA® drone competition, please complete the form found here:
http://my.crossflightskysolutions.com/2023skillsusa/



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INTRODUCTION

Purpose

To evaluate team members' skills and preparation for employment in multiple career fields related to the safe and efficient use of drone technology in the National Airspace System and to recognize outstanding performance by participants in real-world, scenario-based situations.

Competition Specifics

This document was created to provide general guidelines for those preparing/facilitating the Commercial sUAS Competition.

Eligibility (team of 2)

Equipment and Materials

- Supplied by the contest facilitator:
  - Arena (20' x 20' x 10' and/or 30' x 30' x 15')
  - Field elements
  - Competition rubrics
  - Login information for online testing system
  - Awards
- Supplied by the team:
  - Fully assembled, tested, and operational drone with onboard camera (please see the Technical and Safety Guidelines on Page 9)
  - Fully charged batteries for drone
  - Laptop (one per student)
  - Eye protection (always required in the contest area)
  - One-page résumé per competitor that will be submitted as a hard copy to the Technical Committee chair during the debrief
  - Official SkillsUSA® polo or uniform (per contest facilitator)

Skills/Competencies to Be Tested by the Contest

- Students can prove knowledge and understanding of FAA regulations.
- Students can safely plan and both manually and autonomously fly small unmanned aircraft system (sUAS; drone) equipment and collect usable data as required.
- Students can store, organize, and deliver/communicate data in an acceptable manner based on industry standards.
- Students can demonstrate and document a valid sUAS operational cycle.
- Students can utilize knowledge and information to troubleshoot repairs for an sUAS.

Academic Skills Expected of Competitors in this Contest

Presentation and communication, programming and flowcharts, engineering design, technical literacy, critical thinking and problem-solving, spatial orientation, accessing and analyzing information, situational awareness, agility and adaptability, safety and social responsibility, environmental awareness, systems thinking, innovation and creativity, attention to detail, applied mathematics, applied science, emotional intelligence

Scope of the Contest

Student teams will be evaluated and scored in four tasks.

Skill and Knowledge Performance

Task 1: Flight Skills: Student teams will need to be able to prove competency in the ability to operate sUAS in a safe and effective manner as a flight team and document appropriately. The teams will be given three scenarios and asked to plan, fly, collect data, communicate, and document based on industry-generated scenarios. Students should have a good understanding of how an sUAS operates and flies as well as all regulations and safety protocol and procedures. Students will be required to prove their skill and competency while flying on a live video feed, and designated school officials will be responsible for safety, protocols, and liability for all flights. It is a strong recommendation of the SkillsUSA committee that these flights be conducted indoors and inside a safe drone arena. Please see suggested flight scenario ideas attached to this document and reach out to the committee for help if needed.

Task 2: sUAS Maintenance Troubleshooting and Repair: Teams will be given scenarios and asked to solve industry-based problems and prove competency in the ability to troubleshoot and recommend corrective repairs common to sUAS. Students will need a detailed understanding of the mechanics of how drones operate, including the functionality of key components such as sensors, controls, and other technologies. This task will include multiple-choice questions, real-world scenarios, schematics, CAD renderings, and possible explanations required.

Task 3: FAA Knowledge Test: Each team member will be tested using FAA knowledge-based questions related to sUAS regulations. Each team member's score will be averaged together. The test will be proctored, and each student must take the test as an individual.

Task 4: Autonomous Flight: Students will be provided a mission scenario and will need to plan and explain all aspects of the flight as well as provide documentation showing calculations and decision-making strategies. Teams may use software of their choice but will need to be able to share results appropriately (for example, DroneDeploy, Pix4D, Litchi, or many others). Evaluation criteria will include but is not limited to effectiveness of mission accomplishment, flight plan efficiency, utilization of available power, cargo weight compensation, data-sharing capability, effective communication, and so on. This competition will be delivered and accepted through a full virtual platform, but pictures/scans of documents will be provided as well as other file uploads.

Commercial sUAS (Drone) Competition Standards 2023

S-1: Students can prove knowledge and understanding of FAA regulations.	
Standard 1 Competencies	1.1 – Regulations
	1.2 – Airspace and requirements
	1.3 – Weather
	1.4 – Loading and performance
	1.5 – Operations
S-2: Students can safely plan and both manually and autonomously fly sUAS (drone) equipment and collect usable data as required.	
Standard 2 Competencies	2.1 – Professionalism for aviators in dress, attitudes, and all aspects of flight operations
	2.2 – Autonomous flight planning
	2.3 – Photogrammetry flight planning
	2.4 – Camera and other necessary sUAS settings
	2.5 – Part 107 regulations and operating requirements are met
	2.6 – Acceptable aviation communication during all aspects of flight tasks
	2.7 – Knowledgeable of GPS and GNSS location services, devices, and accuracies
	2.8 – Conduct environment mapping and event-related object searching
	2.9 – Locate objects and create archive according to mission plan
	2.10 – Detect obstacles and environmental hazards during mission execution
S-3: Students can store, organize, and deliver/communicate data in an acceptable manner based on industry standards.	
Standard 3 Competencies	3.1 – Provide adequate information and planning for data that applies to personal privacy and data storage
	3.2 – Processing of photos for 2-D map and 3-D model
	3.3 – File-naming conventions
	3.4 – Delivery of data in a timely, acceptable, and understandable manner
S-4: Students can demonstrate and document a valid sUAS operational cycle.	
Standard 4 Competencies	4.1 – Preflight planning
	4.2 – Preflight briefing
	4.3 – Launch
	4.4 – Flight
	4.5 – Recovery
	4.6 – Debrief
S-5: Students can demonstrate creative problem-solving abilities, data analysis skills, and the ability to adequately document their findings.	
Standard 5 Competencies	5.1 – Documentation
	5.2 – Use a systematic approach to solve technical problems
	5.3 – Sketching skills
	5.4 – Work and communicate as part of a team
	5.5 – Flowcharts, pseudocode, and programming
	5.6 – Communicate technical information effectively

(Continued on the next page)

S-6: Students can utilize knowledge and information to troubleshoot repairs for an sUAS.	
Standard 6 Competencies	6.1 – Key airframe, hardware, processing, and sensing components of sUAS
	6.2 – Key interdependent components coordinate to enable operations
	6.3 – Wiring for correct polarity, location, and configuration
	6.4 – Flight controller orientation and wiring configuration
	6.5 – Propeller orientation, rotation, and configuration
	6.6 – Electronic speed controller (ESC) polarity and orientation
	6.7 – Structural, battery, and other damage from operations
	6.8 – Arming the sUAS for flight mode
	6.9 – sUAS improper response to transmitter stick movements
	6.10 – Pitch or roll drifting during flight
	6.11 – Oscillations (lack of stability) during flight
	6.12 – sUAS veering off GPS coordinate flight path

SkillsUSA CHAMPIONSHIPS

Commercial sUAS (Drone) Competition Rubric

Team No.: _____ Date: _____ Judge No.: _____

Task 1: Flight Skills - 250 points	
Standard 2	**Students can safely plan and both manually and autonomously fly sUAS (drone) equipment and collect usable data as required.**
	2.1 – Professionalism for aviators in dress, attitudes, and all aspects of flight operations
	2.4 – Camera and other necessary sUAS system settings
	2.5 – Part 107 regulations and operating requirements are met
	2.6 – Students use acceptable aviation communication during all aspects of flight tasks.
	2.8 – Conduct environment mapping and event-related object searching
	2.9 – Locate objects and create archive according to mission plan
	2.10 – Detect obstacles and environmental hazards during mission execution
Standard 3	**Students can store, organize, and deliver/communicate data in an acceptable manner based on industry standards.**
	3.4 – Delivery of data in a timely, acceptable, and understandable manner
Standard 4	**Students can demonstrate and document a valid sUAS operational cycle.**
	4.1 – Preflight planning
	4.2 – Preflight briefing
	4.3 – Launch
	4.4 – Flight
	4.5 – Recovery
	4.6 – Debrief

Flight Scenario 1: The objective of this flight scenario is to find hidden objects. Team communication is necessary for successful completion of this scenario. These objects can be under, between, or on top of some structure or object. The object has an indicator, such as number or colored sticker, that the drone has to be able to photograph and relay to the drone operator. This indicator corresponds to a landing pad that the operator must then navigate the drone to and land on.

Flight Scenario 2: The objective of this flight scenario is to identify specific objects mixed in with similar objects (for example, with two different colors of foam balls, the pilot must identify the colors while knocking each colored ball off of a stand). The drone will need to inspect and locate each object, based on the requested sequence outlined by the competition facilitator.

Flight Scenario 3: The objective of this flight scenario is to fly to an object that is at least six feet tall. The course includes multiple landing pads (at least three). Each of these landing pads has a different difficulty level. Each landing pad has a small target with at least three concentric circles. Flight skills are proven based on the pilot's ability to land the drone on less accessible landing pads, on smaller landing pads, and centered on the landing pads.

See Page 11 for visuals of the suggested field elements.

Commercial sUAS (Drone) Competition Rubric

Task 2: sUAS Maintenance Troubleshooting and Repair - 250 points	
Standard 6	**Students can utilize knowledge and information to troubleshoot repairs for an sUAS.**
	6.1 – Key airframe, hardware, processing, and sensing components of sUAS
	6.2 – Key interdependent components coordinate to enable operations
	6.3 – Wiring for correct polarity, location, and configuration
	6.4 – Flight controller orientation and wiring configuration
	6.5 – Propeller orientation, rotation, and configuration
	6.6 – Electronic speed controller (ESC) polarity and orientation
	6.7 – Structural, battery, and other damage from operations
	6.8 – Arming the sUAS for flight mode
	6.9 – sUAS improper response to transmitter stick movements
	6.10 – Pitch or roll drifting during flight
	6.11 – Oscillations (lack of stability) during flight
	6.12 – sUAS veering off GPS coordinate flight path

Task 3: FAA Knowledge Test - 230 points	
Standard 1	**Students can prove knowledge and understanding of FAA regulations.**
	1.1 – Regulations
	1.2 – Airspace and requirements
	1.3 – Weather
	1.4 – Loading and performance
	1.5 – Operations

SkillsUSA CHAMPIONSHIPS

Commercial sUAS (Drone) Competition Rubric

Task 4: Autonomous Flight - 245 points	
Standard 1	**Students can prove knowledge and understanding of FAA regulations.**
	1.1 – Regulations
	1.2 – Airspace and requirements
	1.3 – Weather
	1.4 – Loading and performance
	1.5 – Operations
Standard 2	**Students can safely plan and both manually and autonomously fly sUAS (drone) equipment and collect usable data as required.**
	2.2 – Autonomous flight planning
	2.3 – Photogrammetry flight planning
	2.4 – Camera and other necessary sUAS system settings
	2.5 – Part 107 regulations and operating requirements are met
	2.6 – Students use acceptable aviation communication during all aspects of flight tasks.
	2.7 – Students are knowledgeable of GPS and GNSS location services, devices, and accuracies.
	2.8 – Students can conduct environment mapping and event-related object searching.
Standard 3	**Students can store, organize, and deliver/communicate data in an acceptable manner based on industry standards.**
	3.1 – Students can provide adequate information and planning for data that applies to personal privacy and data storage.
	3.2 – Processing of photos for 2-D map and 3-D model
	3.3 – File-naming conventions
	3.4 – Delivery of data in a timely, acceptable, and understandable manner
Standard 4	**Students can demonstrate and document a valid sUAS operational cycle.**
	4.1 – Preflight planning
	4.2 – Preflight briefing
	4.3 – Launch
	4.4 – Flight
	4.5 – Recovery
	4.6 – Debrief

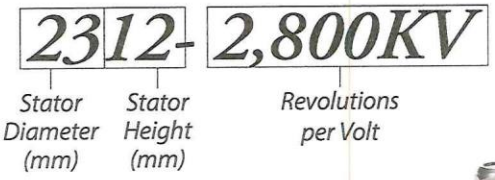
SkillsUSA Professional Development Test - 25 points	
	SkillsUSA Professional Development Test
	Team Score

Technical and Safety Guidelines

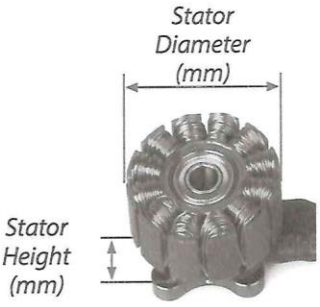
Airframe: There are no limitations regarding the design of the sUAS airframe; small, medium, large sizes as well as different shapes and configurations are all welcome. Please refer to page 11 for dimensions of the field elements to ensure your drone can maneuver through the course. Drones heavier than 3.5 pounds are not permitted in the competition unless special permission is granted.

Number of Rotors: There are no limitations to the number of rotors that may be employed on the sUAS airframe.

Maximum Motor Power: Any brand motor is welcome to be used so long as it has a can size no greater than 2312 (size of magnetic stator in millimeters) and power of 2,800 kV (1,000 rpm per volt). Both can size and power should be etched on the outside of the motor housing. If it is not listed on the motor, please bring the motor manufacturer's specifications with you to the competition; these are typically found on the manufacturer's website. See the following diagrams for more information.



The combination of the motor's stator *diameter* and *height* determine its maximum torque value. The motor should be labeled with this information as in the image to the left.



Propeller Safety: Fingers, face, hair, clothing, and other bodily objects must be kept away from the propellers at all times. Safety glasses must be worn any time a propeller is in operation.

Safety Guards: Each rotor, no matter how many have been employed, must be protected and enshrouded by a safety guard that is capable of keeping the outside edge of the propeller from making contact with anything while in operation.

Safety Glasses and Harmful Objects: Safety glasses must always be worn inside and around the field of play. No sharp objects or drone appendages that could potentially cause harm or damage to a person, objects, or playing field are allowed.

Drone and Controller Device: The drone must be capable of taking photographs and the contestant must be able to immediately show the judges the photos at the completion of their task on a display screen. No post-processing of images is allowed. Additionally, the pilot is the contestant who must take the photos.

Connectivity: Controllers that utilize Wi-Fi might experience interference issues within Wi-Fi-dense environments, such as large convention centers. Contestants should be aware that Wi-Fi controllers may work fine in some settings and not in others. It is the responsibility of the contestants to be prepared in situations where Wi-Fi interference occurs. The host facilitators will not be providing alternate drones for contestants.

FPV Equipment: If a contestant utilizes FPV equipment, it must be commercially produced and must be FCC certified without need for a ham radio license.

Minor Violations: The contest judges will assign minor violations as specified if an infraction occurs. They may assign additional violations, which have not been listed, per their discretion, related to sportsmanship, integrity, respect, safety, and so on. A first minor violation is a written warning, a second minor violation is a 50-point deduction, and a third minor violation is team disqualification.

Major Violations: The contest judges also have the authority and discretion to disqualify a team for any single major violation that relates to putting others' safety at risk. NEVER OPERATE sUAS OUTSIDE OF THE EVENT CENTER OR COMPETITION COURSE AS DOING SO WILL RESULT IN IMMEDIATE TEAM DISQUALIFICATION.

Videos

Video explanations for this competition can be found here: http://my.crossflightskysolutions.com/2023skillsusa/

Competition Overview
LMS Directions
Competition Safety Video
Task 1 Description
Task 2 Description
Task 3 Description
Task 4 Description

National Competition: As a reminder, this Guidebook is focused on the National Competition. Each individual state may choose to adjust the event as they desire. The Competition Committee has outlined numerous safety specifications in the Guidebook, with hopes the states will ensure the same level of student safety.

Learning Management System (LMS)

As a part of the Commercial sUAS (Drone) Competition, certain tasks can be scored through an online learning management system (LMS). Access to the LMS can be available for all states that are planning a competition. Included in the LMS will be:

- Directions for use, portals for submissions, and assessments for all tasks being evaluated.
- Early access to information about requirements that may be shared with participants and schools (including video tutorials).
- Access for competition facilitator for scoring and viewing of submitted requirements.

Field Element Examples

Flight Scenario 1 Example

Flight Scenario 2 Example

Flight Scenario 3 Example

Links to SkillsUSA Components

Drone (Pitsco): https://www.pitsco.com/Tello-EDU-Drone-5-Pack

Drone (MINDS-i): https://mindsieducation.com/collections/competition-gear

Field Elements: https://www.pitsco.com/Drone-Industry-Field-Elements-Kit

Arenas: https://www.pitsco.com/Drone-Arena-10-x-20 and https://www.pitsco.com/Drone-Arena-20-x-20

FAA Testing Supplemental: https://www.pitsco.com/FAA-Testing-Supplemental

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HAVE QUESTIONS?

Email us at skillsdrones@pitsco.com.

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