2024 Collegiate Design Series
SAE Aero Design Rules

Version 2024.0

Forward

Welcome to SAE Aero Design 2024! This competition has been affording students with relevant aircraft design challenges and real-world engineering experience since 1986. Technical competition is a hallmark of the aerospace industry. This competition introduces students to the concepts of design, manufacture, and performance through an industry-like series of events.

During the SAE Aero Design competition students will demonstrate and compete their technical acumen to industry-leading judges in three categories: written, oral, and aircraft performance. Students will experience design through development of an aircraft to a rules-set technical performance specification. Manufacturing follows the design phase; students will produce their design in preparation for a two-day fly-off against their peers from other universities from across the world. Students will experience strategic elements of design thinking as accurate performance prediction influences all phases of the competition.

Competitors will enter a new aircraft for one of three classes: Regular, Advanced, and Micro Classes. This year's competition introduces a new rules-set to the Micro Class.

Micro Class: This competition challenges students to develop a small, light-weight aircraft. In the continued spirit of wildfire management, this competition introduces large-volume fluid management concepts to aircraft design.

Regular Class: As the competition's legacy aircraft class, Regular Class focuses on engineering fundamentals for constrained take-off under limited power available. The large airframe size requirements test students' structural design optimization skills to achieve maximum payload weight performance.

Advanced Class: Today's world is prone to environmental tragedy. Students participate in a campaign against an unpredictable and evolving wildfire disaster in both airborne and ground fire-crew resupply. This class challenges students to balance diverse and conflicting requirements and introduces concepts related to autonomy and telemetry.

In addition to the new rules-set for Micro Class, this year the competition's technical presentation is changing focus from the previous design review to a Flight Demonstration Readiness Review. These reviews help students assess their team's preparedness for competition flight demonstration. Engineers in industry are often required to conduct similar reviews for key stakeholders prior to conducting expensive test programs.

Please, read and apply the rules-sets carefully and remain informed on rules clarifications through our Frequently Asked Questions page and submit questions through the competition forum. Finally, the Rules Committee closely reviews feedback each year to bring greater educational value and a better experience, so please participate in the survey after this season.

Our team is excited for the 2024 competition. Our ardent desire is to augment the university education experience through practical application of technical concepts. Please apply as soon as possible to secure your team's registration. If your team is waitlisted, please, continue with your preparations as we are often able to accommodate prepared waitlisted teams as competition deadlines approach. Good Luck!

SAE Aero Design Rules Committee

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1 COMPETITION REQUIREMENTS

1.1 INTRODUCTION

Official Announcements and Competition Information

The SAE Aero Design competition provides undergraduate and graduate engineering students with a real-world design challenge. These rules are developed by industry professionals with a focus on educational value and hands-on experience. These rules compress a typical aircraft development program into one academic year. This competition exposes participants to conceptual design, manufacturing, system integration/test, and verification through demonstration.

SAE Aero Design features three competition classes—Regular, Advanced, and Micro.

1. **Regular Class** is an all-electric class designed to develop a fundamental understanding of aircraft design.
2. **Advanced Class** is an all-electric class designed to inspire students to take a systems approach to problem solving, while encouraging them to explore autonomous flight.
3. **Micro Class** is an all-electric class designed to encourage students to explore multiple design paths through trade-studies to uncover the most effective and efficient approach to solving real industry challenges.

Other SAE Aero Design Competitions:

SAE BRASIL http://www.saebrasil.org.br

1.2 SAE AERO DESIGN RULES AND ORGANIZER AUTHORITY

General Authority

SAE International and the competition organizing bodies reserve the right to revise the competition schedule and/or interpret or modify the rules at any time and in any manner, that is, in their sole judgment, required for efficient and safe operation of the event or the SAE Aero Design series.

Penalties

SAE International and the competition organizing bodies reserve the right to modify the points and/or penalties listed in various event descriptions; to accurately reflect the operational execution of events, or any special conditions unique to the site.

Rules Authority

The SAE Aero Design Rules are the responsibility of the SAE Aero Design Rules Committee and are issued under the authority of the SAE Collegiate Design Series. Official announcements from the SAE Aero Design Rules Committee, SAE International, or the other SAE International Organizers shall be considered part of and have the same validity as these rules. Ambiguities or questions concerning the meaning or intent of these rules will be resolved by the officials, SAE International Rules Committee, or SAE International Staff.

Rules Validity

The SAE Aero Design Rules (www.saeaerodesign.com/go/downloads) dated for the academic year of the competition are the rules in effect. Rule-sets dated for prior competition years are invalid.

Rules Compliance

By entering an SAE Aero Design competition, the team members, Faculty Advisors and other personnel of the registered university agree to comply with, and be bound by, the rules and all rules interpretations or procedures issued or announced by SAE International, the SAE Aero Design Rules Committee and other organizing bodies. All team members, Faculty Advisors and other university representatives are required to cooperate with and follow all instructions from Competition Organizers, officials, and judges.

Understanding the Rules

Teams are responsible for reading and understanding the rules in their entirety. The section and paragraph headings in these rules are provided to facilitate reading and do not affect the paragraph contents.

Loopholes

Anticipating a comprehensive design space covering all possibilities and potential questions about the aircraft's design parameters or the conduct of the competition is virtually impossible. Please keep in mind that safety remains paramount during any SAE International competition. Any perceived loopholes will be resolved in the direction of increased safety. When in doubt, please contact the SAE Aero Design Rules Committee using the FAQ forum early to avoid design impacts at competition.

Participating in the Competition

Teams, team members as individuals, Faculty Advisors and other representatives of a registered university who are present on-site for competition are considered to be "participating in the competition" from the time they arrive until they depart the site at the conclusion of the competition or earlier by withdrawing.

Visa--United States Visas

Teams requiring visas to enter to the United States are advised to apply at least sixty (60) days prior to the competition. Although most visa applications go through without an unreasonable delay, occasionally teams have difficulties and may not be issued visas before the competition.

AFFILIATED STUDENT TEAM MEMBERS WILL HAVE THE ABILITY TO PRINT A REGISTRATION CONFIRMATION LETTER FOR THE INDIVIDUAL EVENT(S) THEY ARE ATTENDING. ONCE A STUDENT TEAM MEMBER AFFILIATES THEMSELVES TO THEIR TEAM PROFILE PAGE UNDER THEIR INDIVIDUAL EDIT SECTION, THEY WILL HAVE THE OPPORTUNITY TO PRINT THEIR PERSONALIZED LETTER WITH THE FOLLOWING INFORMATION: STUDENT'S NAME, SCHOOL'S NAME, THE CDS EVENT NAME, OFFICIAL DATES AND LOCATION(S).

Letters of Invitation

Neither SAE International staff nor any Competition Organizers are permitted to give advice on visas, customs regulations or vehicle shipping regulations concerning the United States or any other country.

Certificates of Participation

SAE International and Competition Organizers do not create Participation Certificates outside of the auto-generated certificate on your team profile page at sae.org.

Certificates are available once students are affiliated to the current competition's team. Certificates will not be available once that competition year closes.

Violations of Intent

A violation of the intent of a rule will be considered a violation of the rule itself. Questions about the intent or meaning of a rule may be addressed to SAE International Officials, Competition Organizers, or SAE International Staff.

Right to Impound

SAE International and Competition Organizers reserve the right to impound any on-site vehicle/aircraft at any time during competition for inspection by Competition Organizers, officials, and/or technical inspectors.

1.3 Society Membership and Eligibility

Society Membership

Individual team members must be members of SAE International or an SAE International affiliate society. Proof of membership, such as a membership card, is required at the event. Students may join online at: https://www.sae.org/participate/membership/join

Teams shall read the articles posted on the SAE Aero Design News Feed (www.saeaerodesign.com/go/news) by SAE International and the other organizing bodies. Teams shall also be familiar with all official announcements concerning the competition and rule interpretations released by the SAE Aero Design Rules Committee.

Team Pilots

Team pilots are not required to be students or SAE International members; however, all pilots shall be current members of the Academy of Model Aeronautics or the Model Aircraft Association of Canada (AMA has an agreement with MAAC). Valid AMA membership cards must be presented at competition prior to flying any team's aircraft. Non-US pilots can obtain a discounted AMA Affiliate membership covering flying activities while in the US by going to the AMA web site and submitting the following form: https://www.modelaircraft.org/files/902.pdf.

1.4 Liability Waiver and Insurance Requirements

All on-site participants and Faculty Advisors are required to sign a liability waiver, which is part of their Fast-Track Registration Form that can be printed off their team registration page. Individual medical and accident insurance coverage is the sole responsibility of the participant.

1.5 Ringers Prohibited

To maintain the integrity of the competition, the Faculty Advisor(s) must prohibit ringers. A ringer is someone with exceptional skills related to the competition (e.g., a professional model builder) that cannot be a legal member of the team but helps the team win points.

1.6 Design and Fabrication

The aircraft shall be designed and built by the SAE International student members without direct involvement from professional engineers, radio control model experts, pilots, machinists, or related professionals. The students may use any literature or knowledge related to R/C aircraft design and construction and information from professionals or from professors, as long as the information is given as a discussion of alternatives with pros and cons and is acknowledged in the references in the design report. Professionals may not make design decisions, nor contribute to the drawings, the report, or the construction of the aircraft. The Faculty Advisor shall sign the Statement of Compliance given in the Appendix.

1.7 Original Design

Any aircraft presented for competition shall be an original design conceived by student team members. Photographic scaling of an existing model aircraft design is prohibited. Use of major components such as wings, fuselage, or empennage of existing model aircraft kits is prohibited. Use of standard model aircraft hardware such as motor mounts, control horns, and landing gear is allowed.

1.8 Official Languages

The official language of SAE Aero Design series is English. Document submissions, presentations and discussions in English are required at all US competitions in the series.

Team members, judges and officials at Non-U.S. competition events may use their respective national languages for document submissions, presentations and discussions if all parties involved agree to the use of that language.

1.9 Unique Designs

Universities may enter more than one team in each SAE Aero Design competition, but each entry must be a unique design, significantly different from each other. If the aircraft are not significantly different in the opinion of the Rules Committee and Organizer, then the university will be considered to have only a single entry and only one of the teams and its aircraft will be allowed to participate in the competition. For example, two aircraft with identical wings and fuselages but different empennages would not be considered significantly different. For guidance regarding this topic, please submit a rules question at www.saeaerodesign.com.

1.10 Aircraft Classification/Duplicate Aircraft

One Team Entry per Class

A university is limited to registering one team per class (Regular, Advanced, Micro).

Backup Aircraft

Any back-up aircraft must complete inspection before flying.

1.11 AIRFRAME ELIGIBILITY

Airframes will only be allowed to compete during a ***single academic year***. An airframe may be entered in both SAE Aero Design East and SAE Aero Design West during the same ***academic year***, but that same airframe may not be used in either competition during the following year. Entering the same airframe in SAE Aero Design West one year and SAE Aero Design East the next year is not allowed.

An airframe is considered "entered to competition" during an academic year once design documentation is submitted. If the airframe does not fly at competition during that same academic year, the airframe is not eligible for competition during future academic years.

The airframe shall be designed within eleven (11) months of competition and constructed within nine (9) months of competition. The airframe includes the fuselage, wings, and tail.

1.12 REGISTRATION INFORMATION, DEADLINES AND WAITLIST

Teams intending to participate in the SAE Aero Design competitions must register online per the registration schedule in Table 1.1. By registering for any university program, the registered University assumes liability of the student project.

Table 1.1 Open Registration Schedule

Event	***Start (Open)***	***End (Closed)***
Registration Window	September 18, 2023 10:00 AM EDT	November 20, 2023 11:59 PM EST

The registration fee is non-refundable and failure to meet these deadlines will be considered a failure to qualify for the competition. Separate entry fees are required for the events.

Team/Class/University Policy

A university or college can only have one team registered per class. The registration fees must be paid within 48 hours of registration to be eligible.

Individual Registration Requirements – ACTION REQUIRED

A team member must be enrolled as degree seeking undergraduate or graduate student at the college or university of the team with which they are participating. Team members who have graduated during the seven (7) months prior to the competition remain eligible to participate.

All participating team members and Faculty Advisors must ensure they are individually affiliated to their respective college or university on the SAE International website (www.sae.org) Team Profile page.

If you are not an SAE International member, go to www.sae.org and select the "Membership" link. Students will select "Student Membership" and answer the series of questions. All student participants must be members of one of the organizations listed in Section 1.3 to participate.

Faculty members who wish to become SAE International members will select "Professional Membership". This is not mandatory for Faculty Advisors.

All student participants, both domestic and international, and Faculty Advisors must affiliate themselves to the appropriate team(s) online prior to competition.

The "Add New Member" button allows individuals to access this page and include the necessary credentials. If the individual is already affiliated to the team, simply select the Edit button next to the name. This must be done separately for each event your team has entered.

Each team member may participate for only one team. If the university or college is entering multiple classes, team members must choose only one team to affiliate and participate with in the competition. For example, students cannot compete as part of a Micro class team and an Advanced class team.

Pre-Registration Information

SAE will utilize a pre-registration process. Teams who placed top 3 overall in their class during the previous competition will be awarded the opportunity to register up to one week prior to general registration. Pre-registration is restricted to the relative class and event (East or West) of the previous year. For example, if you were in the top 3 in your class at SAE Aero Design East in 2023, you can pre-register for that same class at the SAE Aero Design East 2024 event. Starting on September 11th 10:00 AM ET, top placing teams from the 2023 season will have early access to register.

Any team that placed top 3 overall at both events will have to choose one event for pre-registration. The team can then register for a second competition after the one-event registration restriction is lifted on October 2nd.
Here is the list of 2024 pre-registration eligible teams.

****NOTE: When your team is registering, only the student or Faculty Advisor completing the registration needs to be linked to the college or university. All other students and faculty can affiliate after registration has been completed; however, this must be completed no later than two (2) weeks before the competition start date.**

1.13 WAITLIST

Once an event reaches the venue's capacity, all remaining registered team(s) will be placed on a waitlist. The waitlist is capped at sixty (60) spaces per event and closes on the same day registration closes. Once a team withdraws from an event, an SAE International staff member will inform your team by email (the individual who registered the team to the waitlist) that a competition spot has opened. You will have 24 hours to accept or reject the position and an additional 24 hours to complete registration payment. Waitlisted teams shall submit all documents by the deadlines to be considered serious participants and any team that does not submit all documents will be removed from the waitlist.

1.14 POLICY DEADLINE

Failure to meet deadlines

Teams registering for SAE Aero Design are required to submit several documents prior to the competition including a Design Report and Technical Data Sheet. When these documents are not submitted, judges cannot accurately assess the team. Additionally, teams that do not submit the required documents typically do not come to the competition. Teams that do not notify us they are withdrawing create the following problems:

- They are included in the static event schedules and judging time is wasted.
- Their unused registration slot cannot be offered to a team on the waitlist. Additionally, failure to submit the required documents is a violation of the rules.

Late Submission Penalty

Late submission or failure to submit the Design Report, Technical Data Sheet(s), and Drawings by the deadline will be penalized five (5) points per day. If your required documents are received more than five (5) days late, the documents will be classified as "Not Submitted" and your team will not be allowed to participate. Additionally, the automatic withdrawal policy will be in effect.

Automatic Withdrawal Policy

Failure to submit the required Design Report, Technical Data Sheet(s), and Drawings within five (5) days of the deadline constitutes an automatic withdrawal of your team. Your team will be notified before or on the 4th day of no submission that we have not received your documents and after the 5th day your team's registration will be canceled. No refunds will be given.

Activity/Action	*Class*	*East Event Deadline*	*West Event Deadline*
Event Registration	All	11/20/2023 11:59 PM EST	11/20/2023 11:59 PM EST
Design Report Submission	All	1/29/2024 11:59:59 EST	3/4/2024 11:59:59 EST
Frequency Request	Advanced	2/15/2024	2/15/2024
Withdrawal Request	All	Reference www.saeaerodesign.com	

1.15 Faculty Advisor

Each team is expected to have a Faculty Advisor appointed by the college or university. The Faculty Advisor is expected to accompany the team to competition and will be considered by competition officials to be the official university representative. Faculty Advisors may advise their teams on general engineering and engineering project management but may not design any part of the vehicle nor directly participate in the development of any documentation or presentation. Additionally, Faculty Advisors may neither fabricate nor assemble any components nor assist in the preparation, maintenance, or testing of the vehicle. In brief, Faculty Advisors may not design, build, or repair any part of the aircraft. Faculty Advisors may not participate in flight operations during competition weekend except as noted.

1.16 Questions, Complaints and Appeals

Questions

Any questions or comments about the rules should be brought to the attention of the Rules Committee by submitting a question at https://www.saeaerodesign.com.

General information about hotels and other attractions in the area, as well as a schedule of events, will be posted on the SAE International website: https://www.sae.org/attend/student-events/

Complaints

Competition officials will be available to listen to complaints regarding errors in scoring, interpretation, or application of the rules during the competition.

Competition officials will not be available to listen to complaints regarding the nature, validity, or efficacy of the rules themselves at the competition. In other words, the Organizer will not change the rules-set at the field, unless competition safety requires updates.

Appeal / Preliminary Review

A team can only appeal issues related to scoring, judging, venue policies, and/or any official actions *regarding their own team*. Team Captain(s) and/or the Faculty Advisor must bring the issue to the Organizer's or SAE International staff's attention for an informal preliminary review before filing an official appeal.

A team cannot file an appeal to cause harm to another team's standing and/or score.

Cause for Appeal

A team may appeal any rule interpretation, own-team scoring or official actions which the team feel has caused some actual, non-trivial, harm to own-team, or has had a substantive effect on their score.

Teams may not appeal rule interpretations or actions that have not caused the team any substantive damage.

Appeal Format

If a Faculty Advisor or Team Captain(s) feel their issue regarding an official action or rules interpretation was not properly addressed by the event officials, the team may file a formal appeal with the Appeals Committee.

All appeals must be filed in writing (see Appendix B) to the Organizer by the Faculty Advisor or Team Captain(s) only.

All appeals require the team to offer twenty-five (25) points as collateral. If the appeal is successful, the team ***will not*** forfeit the twenty-five (25) points. If the appeal is overruled, the team will forfeit the twenty-five (25) points.

Appeals Period

All appeals must be submitted within thirty (30) minutes of the end of the flight or other competition event to which the appeal relates.

Appeals Committee

When a timely appeal is received, the committee will review the claims. All contentions or issues raised in the formal appeal will be addressed in a timely manner. The consideration in each review is whether the actions in dispute were just and in-line with the intent of the rules. Once the review is completed, a new order will be issued affirming, reversing, or modifying the original determination.

All rulings issued by the Appeals Committee are final.

The Appeals Committee shall consist of a minimum of three members: the Organizer or delegate, SAE International representative, and a Rules Committee member.

1.17 PROFESSIONAL CONDUCT

Unsportsmanlike Conduct

Unsportsmanlike conduct is not acceptable at SAE Aero Design events. If SAE staff and/or Rules Committee members observe unsportsmanlike conduct, SAE Aero Design reserves the right to assess penalty points or remove the team from competition.

Arguments with Officials

Arguments with or disobedience toward any competition official may result in the team's elimination from competition. All team members may be immediately escorted from the competition grounds.

Alcohol and Illegal Material

Alcoholic beverages, illegal drugs, firearms, weapons, or illegal material of any type are not permitted on the event sites at any time during competition. Any violations will result in the immediate expulsion of all team members and Faculty Advisor(s) of the offending school, not just the team member(s) in violation. This rule applies to team members and Faculty Advisors. Any use of illegal drugs or alcohol by an underage person will be reported to local law enforcement authorities for prosecution.

Organizer's Authority

The Organizer reserves the exclusive right to revise the schedule of the competition and/or to interpret the competition rules at any time and in any manner required for efficient operation or safety of the competition.

Ground Safety and Flight Line Safety Equipment

- No open toe shoes allowed. All team members, including Faculty Advisors(s) and pilots, are required to wear CLOSED toe shoes during flight testing and flight competition.
- Smoking is prohibited. Smoking is prohibited in all competition areas.
- Personal Protective Equipment required. All students involved in flight-line launch and recovery operations for all aircraft classes must wear safety glasses.
- Only non-visible Class 1 eye-safe (EN/IEC 60825-1 2014) lasers are allowed. Laser pointers are prohibited.

Line etiquette

To make a flight attempt, teams must form a line and have their aircraft and competition flightlog with them. Flightlog and Aircraft must be present at all times to maintain line position. Holding a space in line without a valid aircraft or flightlog is not permitted and considered unsportsmanlike conduct. If the aircraft and flightlog are not present, the team will be removed from the line. Once a team uses all available flight attempts, they are no longer permitted to stand in line.

1.18 SAE TECHNICAL STANDARDS ACCESS

A cooperative program of SAE International's Education Board and Technical Standards Board is making some of SAE International's Technical Standards available to teams registered for any North American CDS competition at no cost. The Technical Standards referenced in the Collegiate Design Series rules, along with other standards with reference value, will be accessible online to registered teams, team members, and Faculty Advisors.

2 General Aircraft Requirements

2.1 Aircraft Identification

The Team Number as assigned by SAE International must be visible on both the top and bottom of the wing, and on both sides of the vertical stabilizer or other vertical surface if they exist.

1. Aircraft must be identified with the school name, mailing address, and email address either on the outside or the inside of the aircraft.
2. Team Numbers on Regular aircraft shall be a minimum of four (**4**) inches in height.
3. Team Numbers on Advanced Class primary aircraft shall be a minimum of four (**4**) inches in height. Team Numbers on Advanced Class Powered Autonomous Delivery Aircraft (PADA) shall be a minimum of two (**2**) inch in height.
4. Team Numbers on Micro Class shall be a minimum of two (**2**) inch in height.
5. The University name must be clearly displayed on the wings or fuselage.
6. The University initials may be substituted in lieu of the University name, provided the initials are unique and recognizable.

The assigned Team Numbers appear next to the school name on the "Registered Teams" page of the SAE Aero Design section of the Collegiate Design Series website at:

SAE Aero East: https://www.sae.org/attend/student-events/sae-aero-design-east

SAE Aero West: https://www.sae.org/attend/student-events/sae-aero-design-west

2.2 Prohibited Aircraft Configuration

Competing designs are limited to fixed wing aircraft only. Lighter-than-air aircraft, rotary wing aircraft, or auto-gyros and steerable parafoil aircraft are not allowed.

2.3 Empty CG Design Requirement and Empty CG Markings on Aircraft

All aircraft shall meet the following Center of Gravity (CG) related requirements:

1. All aircraft must be flyable at their designated Empty CG position (no payload, ready to fly) on the submitted 2D aircraft drawing.
2. All aircraft must have the fuselage clearly marked on both sides with a CG symbol (Figure 2.1) that is a minimum of 0.5 inches in diameter centered at the Empty CG position +/-0.25 inches, per the submitted 2D drawings. Wing type aircraft may place the CG markings on the bottom of the wing.
3. The Empty CG location will be verified during Safety and Airworthiness Inspection.
4. No empty weight flight is required.

Figure 2-1 – Center of Gravity Symbol

2.4 Gross Weight Limit

Aircraft gross take-off weight may not exceed fifty-five (55) pounds.

2.5 Controllability

- All aircraft must be controllable in flight.
- If an aircraft is equipped with a wheeled landing gear, the aircraft must have a ground steering mechanism for positive directional control during takeoffs and landings. Aircraft cannot rely solely on aerodynamic control surfaces for ground steering.

2.6 Radio Control System

The use of a 2.4 GHz radio control system is required for all aircraft. The 2.4 GHz radio control system must have a functional fail-safe system that will reduce the throttle to zero **immediately** if the radio signal is lost. Teams may have to reset the default on the fail-safe to meet this requirement.

2.7 Spinners or Safety Nuts Required

All powered aircraft must utilize either a spinner or a rounded model aircraft type safety nut. Nylon-insert Lock-Nuts are prohibited. Figure 2-2 shows examples of acceptable hardware.

Figure 2-2 - Spinners and Safety Nut

2.8 Metal Propellers

Metal propellers are not allowed.

2.9 Lead is Prohibited

The use of lead in any portion of aircraft (payload included) is prohibited.

2.10 Payload Distribution

The payload cannot contribute to the structural integrity of the airframe, meaning, the airframe must be able to fly without the payload installed.

2.11 Static Payload Plate Attachment

All static payload plates must be secured with metal hardware that penetrates all payload plates. Payload plates must be secured to the aircraft structure with metal hardware as a single mass inside the designated payload bay, as defined for each competition class.

2.12 Aircraft ballast

Aircraft ballast is allowed. Ballast cannot be in the payload bay and must be properly secured.

2.13 Control Surface Slop

Aircraft control surfaces and linkages must not feature excessive slop. Sloppy control surfaces lead to reduced controllability in mild cases, or control surface flutter in severe cases.

2.14 Servo Sizing

Analysis and/or testing must be described in the Design Report demonstrating the servos are adequately sized to handle the expected aerodynamic loads during flight.

2.15 Clevis Keepers

All control clevises must have additional mechanical keepers to prevent accidental opening of the control clevis in flight.

2.16 Stored Energy Restriction

Aircraft must be powered by the on-board motor. No other internal and/or external forms of stored potential energy are allowed, for example rubber bands or pressure vessels like CO2 cartridges.

2.17 Battery Pack Restrictions

- All Batteries must be commercially available. Homemade batteries are not allowed.
- All batteries must be positively secured so they cannot move under all flight loads.
- The battery bay or location in the aircraft must be free of any hardware or other protrusions that could penetrate the battery in the event of a crash.

2.18 Use of Lasers

The use of lasers for marking/highlighting landing zones or directing an aircraft to a landing zone is prohibited.

2.19 Power Limiter

All classes require the use of a third-party electronic device (power limiter) to limit the power the propulsion system can use. The official power limiter supplier is Neumotors.com. The supplier will ship worldwide. The limiters are only available at the following link:

https://neuracing.us/product-category/saelimiters/

- Repair and/or modifications to the limiter are prohibited.
- The limiter must be fully visible and easy to inspect.
- Only battery, receiver, Battery Eliminator Circuit (BEC), speed control, arming plug, and limiter are allowed within the power circuit.

2.20 RED ARMING PLUG

All electric powered aircraft must use a discrete and removable red arming plug to arm and disarm the aircraft propulsion system. This red arming plug must be integrated into the electrical circuit between the battery and the electronic speed controller (ESC).

1. The red arming plug must be located on the positive (**RED**) wire between the battery and the power limiter.
2. The red arming plug must be located as follows:
   - The arming plug must be past the opposite edge of the wing from the propeller.
   - On a tractor flying wing or delta, the arming plug must be within 2 inches of the wing control surface hinge line or on the trailing edge of the main body/fuselage.

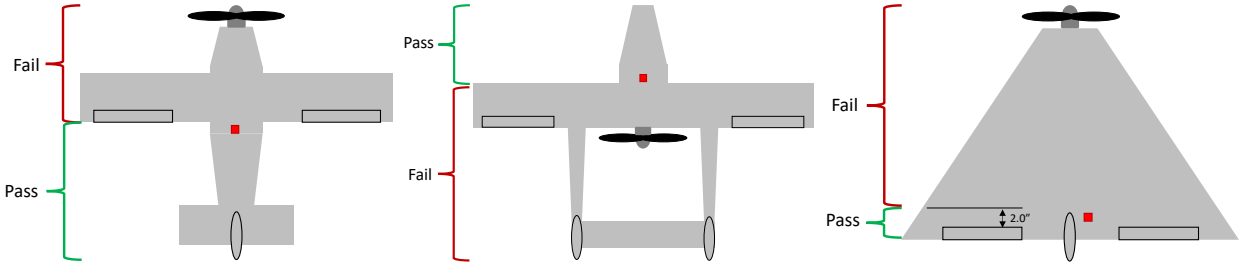
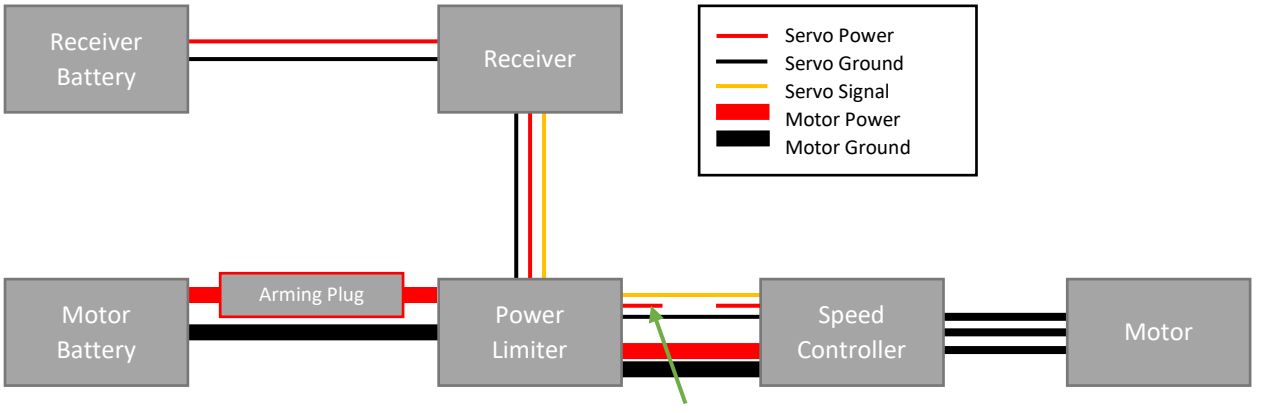


Figure 2-3: Layout diagram of red arming plug on several example aircraft configurations.

3. The red arming plug must be located on the top, near the centerline of the fuselage or wing, and external to the aircraft surface.
4. The red arming plug location must be clearly visible.
5. The non-removable portion of the arming plug interface may not have more than one male lead.
6. Disconnecting wiring harnesses to arm and disarm a system will NOT be allowed.



Note: Speed controllers with a built in BEC should have the positive power wire in the servo connector disconnected. This is to prevent driving the servo power from 2 sources and damaging components.

Figure 2-4: Example diagram of propulsion system with Arming Plug and Power Limiter. Note, different classes may have additional requirements, or allow for alternative configurations.

2.21 Receiver System Battery Pack

A separate battery or separate BEC is required for the receiver system. If using a battery, it must have enough capacity to safely drive all aircraft servos, taking into consideration the number of servos and maximum current draw. The aircraft receiver system must be able to operate without the arming plug installed.

1. The receiver system must have an independent battery pack with a minimum capacity of 1000 mAh.
2. The battery pack must be a LiPo or LiFE type battery.
3. Battery voltage regulators are allowed.
4. The receiver system must be controlled by a clearly visible, properly mounted on/off switch mounted to the aircraft exterior, located at least 12” from the propeller.

2.22 Repairs

1. The original design of the aircraft as presented in the Design Report and presentation must be maintained as the baseline aircraft during the competition.
2. In the event of aircraft damage, the aircraft may be repaired provided such repairs do not drastically deviate from the baseline design. All major repairs must undergo safety inspection before the aircraft is cleared for flight.

2.23 Alteration after Flight

Minor alterations are allowed after the first and subsequent flight attempts. Consult with Rules Committee members to determine if desired changes may be subject to penalty points. Any change made solely for safety of flight will not be subject to penalty points.

3 MISSION REQUIREMENTS AND SCORING

3.1 AIR BOSS

The Air Boss is a qualified SAE event official or appointed volunteer that manages the flight line process. Their responsibilities include:

1. Ensuring safety of the flight line by maintaining an orderly and controlled runway.
2. Being the official of record for the success or failure of the flight, including takeoff and landing.
3. Declaration of flight termination at any time during the flight attempt.

Air Boss, or event organizers, may continue flight operations at their discretion in continuous winds up to 45 knots with gusts no greater than 65 knots.

3.2 PILOT STATION(S)

A pilot area will be defined at pilot briefing. All pilots must fly from the designated area.

3.3 FLIGHT ATTEMPT

Teams are allowed one (1) flight per attempt. There is no fixed or guaranteed number of flights.

A **Flight Attempt** is defined as each time the team brings their aircraft for mission demonstration, starting when the team enters the 'On-Deck' area. Each team will have a limited number of flight attempts for the competition, depending on local conditions.

A **Take-off Try** is defined as trying to get airborne within the time limit.

Airborne is defined as all parts of the aircraft are no longer touching the ground.

A **Bounce** is defined as any part of the aircraft touching the runway after becoming airborne.

For all competition classes the aircraft may be throttled-up/run-up for take-off, subject to the following conditions:

- **Regular Class**: Two (2) team members are allowed to hold the aircraft in place prior to take-off roll.
- **Micro and Advanced Classes**: One (1) team member is allowed to hold the aircraft in place prior to take-off roll.
- The aircraft holder may not push the aircraft on release.
- **Regular and Micro Classes:** the main gear must remain on the take-off line prior to release.

3.4 AIRCRAFT CONFIGURATION AT LIFTOFF AND DURING THE FLIGHT ATTEMPT

The aircraft must remain intact during a flight attempt to receive full flight score.

A twenty-five percent (25%) deduction from the flight score will be assessed if any of the following items are observed to completely detach from the aircraft during a flight attempt.

- Stickers
- Tape
- Coverings

If any components, other than a broken propellor during landing, fall off during a flight attempt, the flight will be disqualified.

3.5 Competition Circuit Requirements

1. During departure and approach to landing, the pilot must not fly the aircraft in a pattern that will allow the aircraft to enter any of the no-fly zones.
2. No aerobatic maneuvers will be allowed at any time during the flight competition in any competition class. This includes but is not limited to: loops, figure 8's, Immelmann, all types of rolling maneuvers, and inverted flight.
3. Regular and Micro Class aircraft must successfully complete a minimum of one (1) complete 360° circuit around the field. See Table 3.2 for additional information.
4. Advanced Class has no specific flight pattern. (See Advanced Class rules concerning the releasable payload drop mission element.)

3.6 Time Limits and Multiple Takeoff Tries

- Multiple takeoff tries per flight attempt may be allowed for some classes within the class-specific time allotment. Refer to Table 3.1 for specific information.
- If an airborne aircraft returns to the ground after being airborne and is beyond the take-off limits, the flight attempt will be disqualified.

Table 3.1: Flight Attempt Information

Class	**Time Limit (sec)**	**Can make multiple take-off tries if:**			**Take-off Try is defined as the point at which:**
		Still within the Time Limit	Bounce within required take-off distance	Bounce outside the required take-off distance	
Regular	120	Yes	Yes	No	The aircraft leaves the starting line and moves forward under its own power
Advanced	60*	Yes	Yes	No	
Micro	60	No	No	No	

*See On-Deck Area for timing of system startup and data connection

3.7 On-Deck Area

The 'On-Deck Area' is an area near the flight line where teams will prepare for their flight attempt.

- Teams will surrender one (1) flight attempt when directed to the On-Deck Area as they wait for their turn to take the flight line.
- Teams may mount propellers, perform control surface checks, and range checks.
- Teams may decide, or be directed by the Airboss or Pitboss, to leave the On-Deck Area for maintenance and/or technical issues but will forfeit the flight attempt.
- Advanced class will have three (3) minutes to turn on and connect their DAS and ground systems. If the team cannot establish a connection within the time limit, they will be directed to leave the On-Deck Area and forfeit the flight attempt.
- Teams should have enough reserve power for any expected delays.
- Teams will not be allowed to install their propulsion arming plugs.
- Motor runup and testing will not be allowed.

3.8 Take-off

Take-off direction will be determined at the discretion of the Air Boss. If possible, the take-off direction will face into the wind. Changes in wind direction, in light and variable winds, may affect the take-off direction throughout the day. SAE Aero Design reserves the right to change the take-off direction at any time for weather or safety reasons.

1. All aircraft must remain on the runway during the take-off roll.
2. Table 3.2 defines distance requirements.
3. Making the initial turn before passing the "distance from initial start before turn" requirement will disqualify the flight attempt.

Table 3.2: Take-off Information

Class	Take-Off Distance Limits	Distance from initial start before turn	Description
Regular	100 ft.	400 ft.	Aircraft must be airborne within the prescribed take-off distance.
Advanced	None	None	Aircraft will have the full use of the runway.
Micro	See Section 9.5	400 ft.	Team may use the entire launch area per attempt to get the aircraft airborne. Only one (1) launch release per flight attempt is allowed.

3.9 Landing Requirements

A successful landing is defined as a controlled return to the ground. Aircraft must remain inside the specified landing zone for each class. The aircraft may leave the landing zone only if given permission by the Air Boss.

The landing zone is a pre-determined, fixed area for each class for the purpose of returning aircraft to the ground. See Table 3.3 for class requirements.

1. The landing zones will be visibly marked prior to the start of competition.
2. It is the team and pilot's responsibility to be aware of the class-specific landing zone dimensions.
3. Any aircraft that leaves the designated landing zone or the paved runway for any reason during landing is subject to a fifty percent (50%) penalty of any points earned during the flight attempt prior to landing.
4. Any flight where the aircraft does not make initial touch down for landing inside the designated landing zone is disqualified.
5. Touch-and-go landings are not allowed and will be judged as a failed landing.
6. The criterion for being within the landing zone is that no supporting part of the aircraft touching the ground can be outside the landing zone. For example, a wing tip or fuselage can overhang the edge of the landing zone, as long as no supporting part of the aircraft is physically touching outside the landing zone.

Table 3.3: Landing Distance Limit

Class	Landing Distance Limits (ft.)	Description
Regular	400 ft.	Aircraft must land in the same direction as take-off. Aircraft must stop within the designated landing zone to avoid a penalty (ref 3.9.3).
Advanced	Available Runway	
Micro	200 ft.	

3.10 Grounding an Aircraft

1. An aircraft will be grounded if it is deemed non-flightworthy or not in compliance with the rules by any SAE official, event official or a designated technical/safety inspector.
2. Until the non-flightworthy or out-of-compliance condition has been addressed and cleared by re-inspection, the aircraft will not be allowed to fly.

3.11 No-Fly Zone

Each competition will have venue-specific **no-fly zones**. The no-fly zones will be defined during the pilot's briefings.

1. At no time will an aircraft enter the no-fly zones, whether under controlled flight or uncontrolled.
2. The first infraction for crossing into the no-fly zone will result in a disqualified flight attempt and zero points will be awarded for that flight.
3. A second infraction will result in disqualification from the entire event and a loss of all points.
4. It is the team and pilot's responsibility to be aware of the no-fly zones and to comply with all venue-specific rules.

5. If a team is unable to directionally control their aircraft and it is headed towards or is in a no-fly zone, the Judges and/or Air Boss may order the pilot to intentionally crash the aircraft to prevent it from endangering people or property. This safety directive must be followed immediately, if ordered by the officials.

3.12 Flight Rules Announcement

Flight rules will be explained before the flight competition begins during a pre-competition pilots' meeting.

3.13 Flight Rules Violations

1. Violation of any flight rule may result in the team being eliminated from the competition.
2. All members of an eliminated team may be escorted from the grounds.

3.14 Local Field Rules

In addition to competition rules, the local flying club may have additional rules in place at the event flying field.

1. Club rules will be obeyed during the competition.
2. If club rules conflict with competition rules, it is the responsibility of the Team Captain(s) and/or Faculty Advisor to bring attention to the conflict and follow the appeals process to resolve the conflict.

3.15 Competition Scoring

A team's final, overall score is composed of scores in the following categories:

1. Technical Design Report (Design Report and Drawing)
2. Presentation
3. Flight Event
4. Penalties

Teams must participate in the design report, presentation, and flight event categories to be included in the competition for overall score. Passing Requirements Check & Safety and Airworthiness inspection counts as participating in the Flight Event.

3.16 Aircraft Empty Weight Definition

All aircraft parts that are not payload, as defined in the relevant class's section, contribute to the empty aircraft weight, including, but not limited to: airframe, receiver, electronics, batteries, hardware, brackets, straps, and other associated features.

4 DESIGN REPORT

The Design Report is the primary means for a team to convey the story of how their aircraft is the most suited design to accomplish the mission. The Design Report should explain the team's thought processes and engineering philosophy that drove their conclusions.

Some important topics to cover are: selection of the overall vehicle configuration, wing planform design including airfoil selection, drag analysis including three-dimensional drag effects, aircraft stability and control, power plant performance including both static and dynamic thrust, and performance prediction. Other topics should be included as appropriate. See the SAE Aero Design Report Guidelines available at www.saeaerodesign.com/go/downloads for additional comments, suggested topics, and a suggested outline. For more information regarding performance prediction, a white paper by Leland Nicolai is also available at http://www.saeaerodesign.com/go/downloads

4.1 SUBMISSION DEADLINES

The Technical Design Report, 2D drawing, and supplemental Tech Data Sheet (TDS) must be electronically submitted to www.saeaerodesign.com no later than the date indicated on the Action Deadlines given on the SAE International Website:

https://www.sae.org/attend/student-events

Neither the Organizer nor the SAE International is responsible for any lost or misdirected reports, drawings, or server routing delays. SAE International will not receive any paper copies of reports through regular mail or email.

4.2 ORIGINAL WORK

The Technical Design Report shall be the team's original work for the current competition. Resubmissions of **previous and current** year's design reports will not be accepted. Recitation of previous year's work is acceptable **if and only if** appropriately cited and credited to the original author(s). Plagiarism is a forbidden industry and academic practice. All references, quoted text, and reused images from any source shall have appropriate citation within the text and within the Technical Design Report's Table of References, providing credit to the original author and editor.

Reports may be checked against **previous and current** submissions to determine if re-use, copying, or other elements of plagiarism are indicated.

For the SAE Aero Design Competition, plagiarism is defined as any of the following:

1. Use of information from textbooks, reports, or other published material without proper citation
2. Use of sections or work from previous SAE Aero Design competitions without proper citation

If plagiarism is detected in the written report, a team will be given 24 hours to make a case to SAE and the Rules Committee. If the report and/or case is found to be insufficient, the team will receive zero score for the report. The team will be allowed to compete in all remaining categories of the competition but will not be eligible for awards. SAE reserves the right to notify the University.

If plagiarism is detected in the oral presentation, the team will receive zero score for the presentation. The team will be allowed to compete in all remaining categories of the competition but will not be eligible for awards. SAE reserves the right to notify the University.

The SAE Aero Design Rules Committee & SAE International has the sole discretion to determine whether plagiarism is indicated, and the above rules are enacted. The above rules may be implemented at any time before, during, or for up to six (6) months after the competition event.

4.3 Technical Design Report Requirements

The Technical Design Report will be 50 points (pts) of the competition score as detailed in Table 4.3.1.

- The Technical Design Report shall not exceed thirty (30) pages, including the cover page, Certificate of Compliance, and 2D Drawing. If the design report exceeds thirty (30) pages, the judges will only score the first thirty (30) pages.
- The Technical Design Report shall include a Cover Page with Team Name, Team Number, and School Name and Team Member Names.
- The Technical Design Report shall include a current Certificate of Compliance signed by hand by the team's Faculty Advisor.
- The Technical Design Report shall be typewritten and double-spaced. Tables, charts, and graphs are exempt from this. For single-spaced reports, only the first fifteen (15) pages will be scored. All other content sections will receive zero (0) points.
- The font shall be 12 pt. proportional; or 10 char/in. non-proportional font.
- The margins shall be: 1" Left, 0.5" right, 0.5" top, and 0.5" bottom.
- Each page, except the Cover Page, Certificate of Compliance, 2D Drawing and Technical Data Sheet shall include a page number.
- All report pages shall be ANSI A (81/2 x 11 inches) portrait-format.
- The Technical Design Report shall include a Table of Contents, Table of Figures, Table of Tables, Table of References and Table of Acronyms.
- The Technical Design Report shall be single-column text layout.
- The Technical Design Report shall include the Technical Data Sheet(s) (TDS) appropriate for the team's competition class. The TDS must include the Team Name, School Name, and Team Number.

Table 4.3.1 Technical Design Report

Section	Page Count	Points		
		Regular	Advanced	Micro
Cover Page	1	40	40	40
Certificate of Compliance	1			
Design Report	27			
2D Drawing	1	5	5	5
Total Document	**30**	**45**	**45**	**45**
TDS: Payload Prediction	1	5	-	-
TDS: Powered Autonomous Delivery Aircraft 2D Drawing	1	-	2.5	-
TDS: Air-Systems Operations Plan	1		2.5	
TDS: Vehicle Performance	1	-	-	5
Total		**50 pts**	**50 pts**	**50 pts**

4.4 2D Drawing Requirements

2D Format and Size

The 2D drawing must be one (1) ANSI B sized page (PDF) format (11 x 17 inches). For teams outside North America that cannot submit an ANSI B size drawing, page format size must be the closest size available to ANSI B.

Markings Required

The 2D drawing must be clearly marked with:

1. Team Number
2. Team Name
3. School Name

Views Required

Drawings shall include at a minimum, a standard aeronautical 3-view orthographic projection arranged as described:

1. Left side view, in lower left, with nose pointed left.
2. Top view, above and aligned with the left side view, also with nose pointed left (wing-span break-view permitted).
3. Front view aligned to side view, located in the lower right (projection view non-standard movement as noted by projection view arrows in accordance with ANSI-Y14.5M 1994).

Dimensions Required

Drawing dimensions and tolerance shall be in English units, decimal notation accordance with ANSI-Y14.5M 1994 to an appropriate level of precision to account for construction tolerances (allowable variation from analyzed prediction to account for fabrication) (i.e. X.X = ± .1 in; X.XX = ± .03 in; X.XXX = ± .010 in).

The minimum required dimensions/tolerances are: aircraft length, width, and height.

Summary Data Required

The drawing shall contain a summary table of pertinent data to include but not limited to:

1. Wingspan
2. Wing Area
3. Aspect Ratio
4. Empty weight
5. Battery(s) capacity
6. Motor make and model
7. Motor KV
8. Propeller manufacturer, diameter, and pitch
9. Servo manufacturer, model number, and torque specification in ounce-inches for each aircraft servo. Identify the servo being used at each position on the aircraft.

Weight and Balance Information

The 2D drawing shall contain the following weight, balance, and stability information:

1. A clearly marked and labeled aircraft datum
2. A weight and balance table containing pertinent aircraft equipment. Each item must show its location from the aircraft datum in inches (the moment arm), the force, and resultant moment. See www.saeaerodesign.com/go/downloads for additional information. The minimum pertinent equipment list includes:
    a. Motor
    b. Battery(s)
    c. Payload(s)
    d. Electronics
3. Aircraft mean aerodynamic cord, stability margin and Center of Gravity (CG) information listed below must be clearly shown on drawing.
    a. Aircraft mean aerodynamic chord
    b. Stability margin for loaded CG and empty CG
    c. Empty CG location (flightworthy)
    d. Fully loaded CG (flightworthy, with payload, if applicable)

4.5 TECH DATA SHEET: PAYLOAD PREDICTION (REGULAR CLASS ONLY)

Regular Class must include a total payload prediction curve as part of the technical report. The graph represents an engineering estimate of the aircraft's lift performance based on density altitude.

1. Graph of payload weight shall be linearized over the relevant range.
2. The linear equation shall be in the form of:

$$y = mX + b$$

Y = Payload weight (lbs.)
X = Density Altitude (feet)
m = Slope of the linear line
b = y-intercept.

3. Only one line and one equation may be presented on the graph. This curve may account for predicted headwind for local conditions, rolling drag, inertia, motor and propeller performance, or any other factors that may affect take-off performance. All these factors are allowed components of the prediction curve, but only one curve will be allowed; multiple curves for varying headwind conditions will not be allowed.
4. The team must provide a brief explanation of how the line was generated in the report. The report section containing this information must be noted on the payload prediction curve.
5. Graph axes shall be in English units, decimal notation.

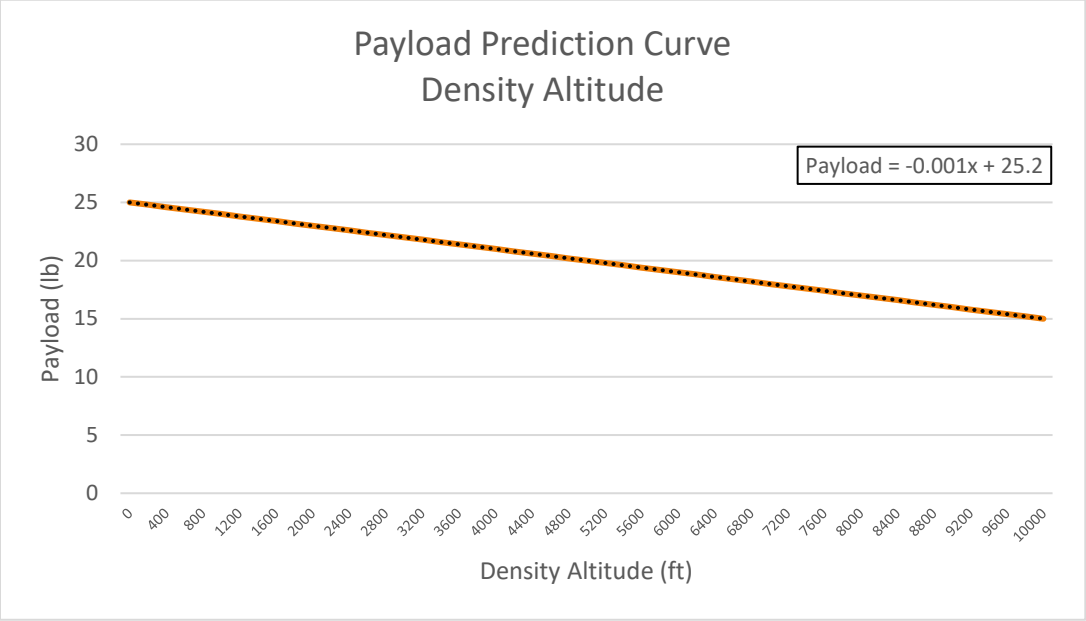


Figure 4-1: Example Regular Class Payload Prediction Curve

4.6 Tech Data Sheet: Powered Autonomous Delivery Aircraft (Advanced Class Only)

An additional 2D drawing must be provided as an Appendix for Powered Autonomous Delivery Aircraft (PADA). This 3-view must be ANSI B sized page (PDF) format (11 x 17 inches) and follow the same requirements as the primary aircraft 2D drawing.

1. Drawings shall identify the location of the loaded CG.
2. Teams shall provide a list of avionics and equipment.
3. Teams shall provide a prediction of PADA landing accuracy. This shall be a histogram of the results of simulated PADA landings, binned in one-foot increments.
4. Teams must provide a standard deviation (in feet) assuming a mean of 0ft to be used in the calculation of their PADA Landing Bonus.

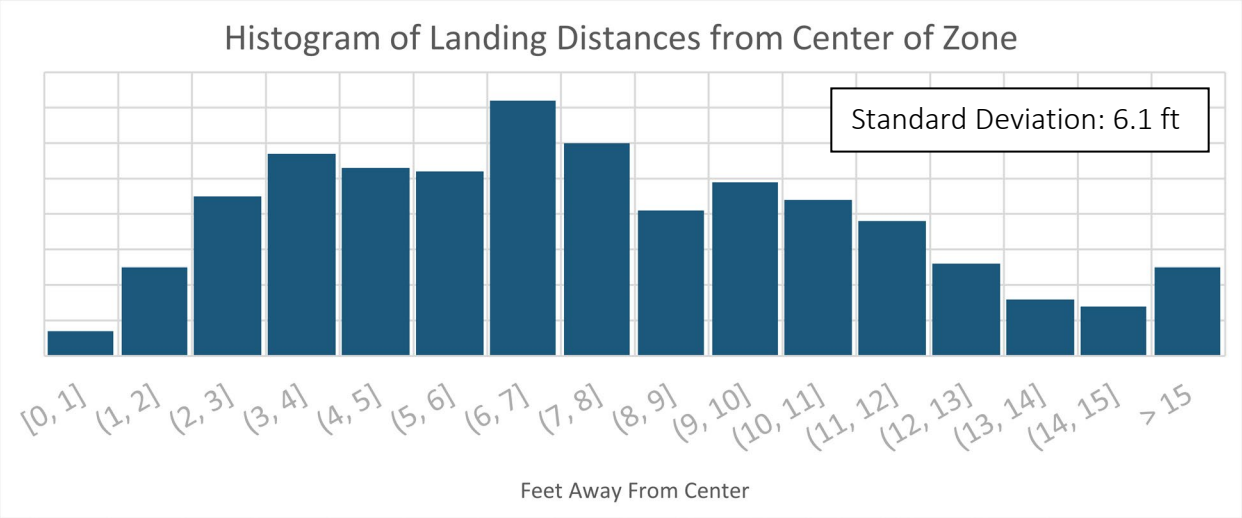


Figure 4-2: Example of Advanced Class Landing Distance Histogram

4.7 Tech Data Sheet: Air-Systems Operations Plan

Advanced class must provide a sheet describing the systems' operations plan and components as a block diagram. Show the breakdown of each system's functionality and interactions.

1. The diagram should represent the PA, PADA, Ground Station, and pilot(s)
2. Describe all communication methods between systems. Document any frequencies used and provide the make/model of any RF transmitters.

4.8 Tech Data Sheet: Aircraft Performance Prediction (Micro Class Only)

Micro class must provide a plot of the aircraft's neutral point and a plot of static margin on a single page, each from -10 degrees to +15 degrees angle-of-attack with the water container half-full. Teams should include a paragraph discussing stability accounting for water movement.

5 FLIGHT DEMONSTRATION READINESS REVIEW

Prior to conducting expensive test campaigns, professional engineers are required to complete technical readiness reviews with senior technical leadership and independent reviewers to ensure the team, hardware, and software are ready to complete test objectives in support of a program's mission milestones. These reviews require the engineers to possess a well-developed ability to synthesize issues, detail outstanding items, evaluate risk and communicate effectively.

The competition technical presentation will now be focused on a Flight Demonstration (Demo) Readiness Review (FDRR) allowing teams the opportunity to demonstrate they are ready to perform safely in the competition's flight operations. Teams can obtain a maximum FDRR score of fifty (50) points. The score shall be comprised of scores from each judge based on the judges' evaluation of the technical content and the team's readiness to compete.

5.1 PRESENTATION REQUIREMENTS

1. The FDRR shall be timed with a follow-on, timed "Question and Answer" (Q&A) period. The time limits are detailed in Table 5.1 (Regular and Micro Class) and Table 5.2 (Advanced Class).
2. The FDRR shall be delivered in English.
3. The FDRR shall address, but is not limited to: demo overview, preflight predictions, demo hardware & software pedigree and readiness, competition first time events & demo risks, outstanding major milestones prior to competition, demo team roles and responsibilities, and post flight risk planning.
    - A **First Time Event** (FTE) is defined as any subsystem tests, assembly & integration, flight testing, new conditions, new pilot, or any other occurrence that may be encountered during competition weekend for the first time.
4. The FDRR is limited to student team members only. Non-team member pilot or Faculty Advisors can attend but are prohibited from participating in the setup, delivery, and/or the Q&A.
5. Use of visual aids are advised. Film clips, if used, may not exceed one-minute total duration. Film clips may not be accompanied by recorded narration.

5.2 PRESENTATION PROCESS AND PROCEDURES

Each presentation room shall have a lead judge with the responsibility to ensure compliance with competition rules and schedule. The lead judge will also identify a timekeeper.

1. With agreement from the speaker, the timekeeper will give the speaker a one (1) minute warning prior to the presentation time limit.
2. If the team exceeds the presentation time limit, the team will be assessed a five (5) point penalty.
3. The presentation shall be stopped after one (1) additional minute.
6. A team shall have time for Q&A immediately following the presentation according to Table 5.1 (Regular and Micro Class) and Table 5.2 (Advanced Class). Questions may be asked by any judge.

4. Any time remaining or exceeding the presentation time limit shall be added to or subtracted from the Q&A time limit.

Table 5.1: Micro and Regular Class Presentation Time Breakdown

Time (Minutes)	Description
2	Setup presentation
12	Present Flight Demo Readiness Review
7	Questions & Answers
1	Close down presentation

Table 5.2: Advanced Class Presentation Time Breakdown

Time (Minutes)	Description
2	Setup presentation
15	Present Flight Demo Readiness Review
7	Questions & Answers
1	Close down presentation

6 REQUIREMENTS CHECK & SAFETY AND AIRWORTHINESS INSPECTION

Requirements Check & Safety and Airworthiness Inspection of all aircraft will be conducted using the published checklists for each class for the current year. The checklists can be found at: www.saeaerodesign.com/go/downloads

Safety and Airworthiness Inspection is the process of checking each aircraft for any issues or problems that could cause a safety problem in flight or on the ground.

Requirements Check is the process of checking all aircraft for:

- Compliance with all General aircraft requirements.
- Compliance with all Class-specific requirements.
- The aircraft presented matches the design submitted by the team.

All aircraft must pass the Requirements Check & Safety and Airworthiness to compete. **Per the Statement of Compliance, teams shall present a fully completed Requirements Check & Safety and Airworthiness Inspection for their aircraft submitted on SAEStars by the Faculty Advisor or Team Captain.** Teams cannot begin the inspection process without meeting this requirement. Inspectors will confirm the team has fully inspected their aircraft.

Inspectors will be given a list of five (5) to seven (7) requirements to spot check, instead of checking all items. These will be randomly chosen before the event. Even though items are being spot checked, teams must comply with all items at all times.

6.1 AIRCRAFT CONFORMANCE TO 2D DRAWING

During Technical Inspection, the aircraft will be inspected and measured for conformance to the 2D drawing presented in the Design Report.

1. At a minimum, aircraft length, wingspan and height dimensions will be measured and compared to the 2D drawing.
2. Aircraft will have the actual empty CG compared to the empty CG presented in the 2D drawing.

6.2 DEVIATIONS FROM 2D DRAWING

Any deviation in construction of the aircraft from the submitted 2D drawing, must be reported in writing. **For Advanced and Regular Class aircraft, there is no need to report deviations in the length (L), width (W), and height (H) of the aircraft, if the following is satisfied, where dimensions are in inches:**

$$\left|L_{actual} - L_{drawing}\right| + \left|W_{actual} - W_{drawing}\right| + \left|H_{actual} - H_{drawing}\right| \leq X \; inches$$

$$Where \; X = 1 \; for \; Micro \; Class \; and \; PADA, 3 \; for \; Regular \; and \; Advanced \; Class$$

6.3 SAFETY AND AIRWORTHINESS OF AIRCRAFT

Safety and Airworthiness Inspection will also assess the general safety and airworthiness of each aircraft by seeking any problems that could cause an aircraft to depart controlled flight. This assessment includes, but is not limited to:

1. Unintentional wing warps
2. Control surface alignment
3. Correct control surface response to radio transmitter inputs
4. Linkage problems
5. Structural and mechanical soundness of aircraft

6.4 Inspection of spare aircraft and spare aircraft components

1. All spare aircraft and spare aircraft components (wings, fuselages and tail surfaces) must be presented for inspection.
2. Teams may submit up to two (2) complete aircraft at inspection on Friday.
3. Additional spare aircraft and parts beyond two (2) sets may be submitted for inspection on Saturday and Sunday.

6.5 Aircraft must maintain Compliance throughout the competition.

1. All aircraft must meet all Requirements Checks & Safety and Airworthiness requirements throughout the competition.
2. Any official may request an aircraft be re-inspected if a general, class configuration, or safety/airworthiness requirement problem is seen on the aircraft at any time during the event.
3. This includes any errors or omissions made by officials during inspection.

6.6 Requirements Check & Safety and Airworthiness inspection penalties

1. If a team fails the spot check process for any of the General Aircraft requirements or Class requirements, there will be a point penalty for each item failed. The aircraft must be brought into compliance to compete.
2. SAE Aero Design reserves the right to assess the point penalty on any requirement item found during inspection, even if the item is not on the spot check list.
3. Any Requirements Check failure involving penalty points will be confirmed by a Rules Committee member.
4. No additional penalty points will be assessed for a team's second aircraft that has the same requirements failure as the first aircraft.
5. If a Requirements Check item failure is found on an aircraft after inspection or during flight rounds, the point penalty will be applied and any flight score earned while the aircraft was non-compliant will be zeroed. The aircraft will have to be brought into compliance before flying again.
6. There are no penalty points for failing any Safety or Airworthiness item. However, the team must correct any failures before the aircraft is allowed to fly. Flight points earned while the aircraft was not in compliance with Safety and Airworthiness requirements may be subject to being zeroed.

7 REGULAR CLASS DESIGN REQUIREMENTS

The Regular Class objective is to design an aircraft that can lift as much weight as required while maximizing wingspan. Payload will consist of Regular Boxed Cargo, represented by payload weights, which must be carried on each flight. Accurately predicting the aircraft lifting capacity is an important part of aircraft design.

7.1 AIRCRAFT DIMENSION REQUIREMENT

Regular Class aircraft must have a minimum planform wingspan of **120** inches.

Regular Class aircraft are limited to a maximum planform wingspan of **180** inches. When not on the flight line, teams will be required to remove outer wing sections for easy transport.

Wings with small chord extensions added to gain span are not allowed. There can be no chord steps or discontinuity in the projected wing drawing. The minimum wingtip chord is 4 inches.

The aircraft must disassemble into components, each of which must measure 48 inches or less, along any primary axis in the flight configuration aircraft body frame. Components permanently attached to each other (i.e., bonded) are considered members the same component.

The aircraft's outer-most wing panels must be at least 42 inches in span as defined in the paragraph above.

7.2 MATERIAL AND EQUIPMENT RESTRICTIONS FOR REGULAR CLASS

Fiber-Reinforced Plastic (FRP)

The use of Fiber-Reinforced Plastic (FRP) is prohibited on all parts of the aircraft. Fiber-Reinforced Plastic includes duct tape. Exceptions include commercially available FRP motor mount, propeller, landing gear, and control linkage components. Exploration of alternative materials is encouraged.

Rubber bands

Elastic material such as rubber bands, shall not retain the wing or payloads to the fuselage.

Stability Assistance

All types of gyroscopic or other stability assistance are prohibited.

Wing Section Joining

No Tape or covering material will be allowed over/on the wing joints.

7.3 AIRCRAFT SYSTEM REQUIREMENTS

Electric Motor Requirements

The aircraft shall be propelled by a single electric motor. There are no restrictions on the make or model of the electric motor.

Gear boxes, Drives, and Shafts

Gearboxes, belt drive systems, and propeller shaft extensions are allowed if a one-to-one propeller to motor RPM is maintained. The prop(s) must rotate at motor RPM.

Aircraft Propulsion System Battery

Regular Class aircraft must be powered by a commercially available 6 cell (22.2volt) Lithium-Polymer battery pack. Minimum requirements: 3000 mAh, 25c.

Power Limiter

Regular Class aircraft must use a 2018 V2 or newer, 750-watt power limiter from the official supplier as described in Section 2.19. If you have a 1000-watt limiter, you can send the limiter back to be changed to 750-watts.

7.4 Payload Requirements

Types of Cargo

Regular Class payload shall consist of Regular Boxed Cargo, which must be carried internally. Payload attachment must be designed for ease of access. Reference Section 7.5 for demonstration details.

Cargo Bay Requirements

Regular Class aircraft shall have a single fully enclosed Cargo Bay for carrying Regular Boxed Cargo with the following additional requirements:

1. The Cargo Bay shall fully enclose the Regular Boxed Cargo. Regular Boxed Cargo may not be exposed to airstream at any point in flight.
2. The Cargo Bay has no restriction on size or shape.
3. Only one Cargo Bay is allowed in a Regular Class aircraft.

Regular Boxed Cargo Support Requirements

Regular Boxed Cargo shall consist of a support assembly and payload plates with the following additional requirements:

1. There is no required configuration for the payload plates, other than as defined by Section 2.10 and 2.11.
2. Teams must provide their own payload plates.
3. Tape, Velcro, rubber bands, container systems and friction systems alone may not be used to retain the support assembly and/or payload plates.

7.5 Regular Class Payload Unloading

To complete a successful flight for score, the post-flight unloading Regular Boxed Cargo must be accomplished within one (1) minute. This demonstration will occur at the weigh station after the completion of each successful flight.

This activity is timed and shall be performed by no more than two (2) team members.

The demonstration will start with all Regular Boxed Cargo loaded and secured, and the aircraft configuration unchanged from the most recent successful flight.

Only Regular Boxed Cargo successfully unloaded within the time limit will be weighed and recorded for scoring that flight.

7.6 REGULAR CLASS SCORING

To participate in the flight portion of the competition, each team is required to have submitted AND received a score for their Design Report and Oral Presentation.

The team's Final Flight Score (FFS) is the sum of the team's top three (3) flight scores achieved during the competition (FS_1, FS_2, and FS_3) and the Wingspan Score.

Scoring Equation:

$$FFS = \ Final\ Flight\ Score = \ FS_1 + FS_2 + FS_3 + WS$$

Where:

$$FS = Flight\ Score = \frac{W_{Payload}}{2} + PBB$$

$$PPB = Payload\ Prediction\ Bonus = MAX\left(5 - \left(W_{payload} - P\right)^2, 0\right)$$

$$WS = Wingspan\ Score = 2^{\left(1+\frac{b}{5}\right)}$$

$W_{Payload} = Regular\ Boxed\ Cargo\ Weight\ (lbs)$

$b = Aircraft\ Wingspan\ (ft)$

$P = Predicted\ Payload$

The predicted payload, P, is determined from the payload prediction curve provided in the Technical Data Sheet (Section 4.5) and the density altitude measured at the event.

The Payload Prediction Bonus will be calculated for each flight. All Payload Prediction Bonus (PPB) scores less than zero (0) will default to zero (0).

Wingspan Score will only be calculated after a team has a successful flight.

Penalty Points

Penalty points assessed during competition are deducted from a team's overall score.

8 ADVANCED CLASS DESIGN REQUIREMENTS

The Advanced Class objective is to design a suite of systems to support the fight against wildfires through the delivery of water and parts for a ground vehicle. This class is focused on mission success through understanding diverse requirements, system-level engineering, and robust execution.

8.1 AIRCRAFT DIMENSION REQUIREMENT

Advanced Class aircraft are limited to a maximum planform wingspan of **120** inches.

8.2 AIRCRAFT SYSTEM REQUIREMENTS

Electric Motor Requirements

The Primary Aircraft shall be propelled by one or more electric motors. There are no restrictions on the make or model of the electric motor.

Gear boxes, Drives, and Shafts

Gearboxes, belt drive systems, and propeller shaft extensions are allowed.

Aircraft Propulsion System Battery

Advanced Class aircraft must be powered by a commercially available 6 cell (22.2volt) Lithium-Polymer battery pack. Minimum requirements: 3000 mAh, 25c.

Power Limiter

All Advanced Class Primary Aircraft shall use a single 2018 or newer, 750-watt power limiter from the official supplier described in Section 2.19.

8.3 RUBBER BANDS

Elastic material, such as rubber bands, shall not retain the wing to the fuselage.

8.4 PRIMARY AIRCRAFT STATIC PAYLOAD REQUIREMENTS

Water Storage Container Requirements

Each team shall provide at least two (2) storage containers: at least one (1) main storage container to hold all the water carried as Static Payload by the primary aircraft and at least one (1) destination storage container to hold all the water delivered by the Ground Transport Vehicle (GTV).

1. After each successful mission, the Static Payload will be impounded into the team's main water storage container(s). Teams will not have access to this water until the GTV demonstration.
2. Containers must be clearly marked with team name and number.
3. Containers should have a sealable lid to prevent spilling.
4. Any evaporation, leakage, or other loss of water is the team's responsibility.

Payload Requirements

1. The primary aircraft shall carry a payload of water.
2. Payload bay(s) shall have no restriction on size or shape.

3. Teams must be able to unload Payload into the main water storage container at the weigh station after flight within three (3) minutes.
4. Any water not unloaded during the time limit shall not be counted for score.

8.5 Powered Autonomous Delivery Aircraft (PADA) Requirements

Teams are responsible for delivering a Ground Transport Vehicle (GTV) safely to the ground through a powered and autonomously delivery aircraft (PADA). The following requirements apply to the PADA:

1. Total weight of each fully loaded PADA must not exceed 16.0 oz.
2. The PADA must be a fixed wing aircraft and is subject Section 1 and 2 requirements.
3. The team may have multiple PADAs, but only one (1) can be mounted and flown on the primary aircraft per flight.
4. The PADA must have a propulsion system, consisting of at least a propeller, motor, battery, and speed controller.
5. The PADA must use a separate battery pack or battery eliminator circuit (BEC) to power the receiver. The red power wire from the ESC must not be connected to the receiver.
6. The CG must be clearly marked on each PADA according to Section 2.3.
7. Payload may be carried internally or externally. There is no restriction on any internal payload bay(s) for size or shape.
8. The PADA shall be considered a structural part of the Primary Aircraft prior to the intentional release and separation towards the target landing zone. The entirety of the PADA is considered payload after release. Section 3.5 will be observed if the PADA loses parts while attached to the Primary Aircraft. Structural components will result in a disqualification of the flight attempt. Non-structural components will result in a 25% penalty.
9. Powered taxi of the PADA is prohibited.

8.6 Landing zones

The PADA is required to land in a pre-selected landing zone. Teams must demonstrate their ability to successfully land in the Static Zone before attempting landings in a Random Zone. The team will draw a random landing zone prior to take-off after completing one successful Static Zone landing.

Static Zone

1. One (1) Zone with a diameter of 30 ft will be placed on the far side of the runway.
2. The GPS coordinates for this zone will be provided to teams and will remain in place throughout the competition.
3. Teams may only successfully land in the Static Zone once.

Random Zone

1. There will be at least three (3) zones, located on the far side of the runway.
2. Each zone will have a diameter of 30 ft, with the center marked by a solid-colored sign of at least 24” in diameter laying flat on the ground.

3. The location of each zone may be changed at any point during the competition.
4. Teams will not be allowed access to the field to obtain GPS coordinates at any time during the competition.
5. Only PADAs that land in the target zone selected for that flight attempt will be counted for score.

8.7 Ground Transport Vehicle (GTV) Requirements

The PADA payload shall consist of components for a ground vehicle, which teams shall assemble and demonstrate at the conclusion of all flight activities. The following requirements apply to the GTV:

1. Other than the water payload and transmitter (if used), the entire GTV system, and everything necessary to construct, operate and maintain it, must be delivered as payload via PADA flights. This includes but is not limited to wheels, batteries, motors, the receiver, fasteners, tools, tape, water funnel, etc.
2. After each successful PADA landing in a Random Zone, any desired GTV components shall be unloaded and placed in an impound box, where they will remain until the GTV demonstration.
3. Teams shall provide their own impound box, which shall be a rectangular prism with a removable lid and marked with the team's name and number.
4. The GTV payload during the ground demonstration shall be water. The water must be drawn from the team's main water storage container filled by the Primary Aircraft. The water shall be delivered to the destination water storage container.

8.8 Gyroscopic and other stability augmentation

Gyroscopic assist or other forms of stability augmentation are allowed in Advanced Class.

8.9 Autonomous flight

Autonomous flight systems that cause the Primary Aircraft to navigate without direct pilot control input are prohibited. Teams must provide at least one fully functional PADA. Autonomous flight for the PADA is required, subject to the following rules:

1. In addition to the motor, the PADA shall have an active navigation system, controlling at least 2 degrees of freedom, guiding the PADA toward the target landing zone following release from the Primary Aircraft.
2. Teams must have a manual override for PADA control through a dedicated secondary transmitter. There shall be a switch on that transmitter to switch between autonomous and manual flight modes.
3. The team must have a dedicated PADA pilot who will use the secondary transmitter if manual override is used. This pilot will stand with the Primary Aircraft pilot near the Air Boss or designated representative.
4. Manual override may be used at the team's discretion. Any use of manual override shall be considered an unsuccessful PADA flight.
5. If the PADA is flying in an unsafe manner, the Air Boss may order grounding of the PADA as per Section 3.11.5. The PADA flight shall be considered unsuccessful.

8.10 Frequency Request Procedure

Advanced Class teams shall fill out Frequency Request form in Appendix C to request frequency assignment for DAS, FPV, or other RF links. Teams must submit the document via email by **February 15th, 2024**. SAE Rules Committee will work with teams to deconflict if multiple teams request similar frequencies.

8.11 Data Acquisition System (DAS)

Advanced Class Primary Aircraft shall have a Data Acquisition System (DAS) to record altitude and be used by the team to locate the appropriate target landing zone. All communication between the payload specialist and any pilot must be in English.

1. Using a ground receiver station, the team must display the real-time altitude of the aircraft to the Payload Specialist and the flight judge in at least 1.0 inch text.
2. Team must automatically record, and immediately display the altitude (ft) at the moment of PADA release in at least 1.0 inch text. The indicator must remain visible for the remaining duration of the flight.
3. The DAS recording must be performed on the ground station and must support play back for review on demand.
4. Altitude must be measured in feet with a display precision of at least one (1) ft and an accuracy error of less than ten (10) ft.
5. The DAS system must use a discrete and removable Red arming plug to apply power. This arming plug is subject to the Section 2.20 requirements. One Red arming plug can be used for both DAS and FPV.
6. DAS equipment may also have a reset switch, if desired. If a manual reset switch is used, it must be located externally at least 12 inches behind the propeller in the longitudinal direction. A wireless DAS reset system is allowed.
7. DAS systems shall not use the same 2.4 GHz band as the flight control system, unless the telemetry being used is part of the radio control system being used. A DAS built into the radio control system must meet all DAS rules requirements.

8.12 DAS Failures

Any DAS failure during a flight attempt is considered a failed flight attempt and receives zero (0) points.

> *Example: A team has flown four (4) times successfully and on the 5th attempt the Primary Aircraft takes-off successfully, makes a successful release, but the DAS altitude reading malfunctions. The flight attempt will NOT be considered a qualified flight and the team will receive zero (0) credit for PADA or static payload for flight 5.*

8.13 First Person View System (FPV)

FPV is not required for Advanced Class. For teams wishing to use an FPV system for operational reasons, the following conditions apply:

1. Teams will be required to follow the frequency request process to receive a frequency for their FPV systems. Frequency control procedures will be in place to prevent conflicts.
2. The primary pilot must fly visually only (no FPV goggles or ground station reference).
3. FPV systems CANNOT use the same frequency as the flight control system. Use of 2.4 GHz for FPV video is prohibited.
4. The FPV system must use a discrete and removable Red arming plug to apply power. This arming plug is subject to the Section 2.20 requirements. One Red arming plug can be used for both DAS and FPV.

8.14 Payload Specialist

The Payload Specialist is responsible for releasing the PADA from the Primary Aircraft.

1. The Payload Specialist must be a single team member. The Payload Specialist should not rely on having a line-of-sight view to the aircraft or target(s).
2. Neither the primary aircraft pilot not the PADA pilot may have access to or activate any PADA release, and the release cannot be connected to the pilot's R/C transmitters in any way.
3. The PADA release must be manually activated by the Payload Specialist or by an automatic release system that is part of the Primary Aircraft electronics.
4. If an automatic release system is used, it must have a manual override controlled by the Payload Specialist.
5. Teams may activate the payload release system using a second 2.4 GHz radio system or some other method based on their DAS or telemetry system.

8.15 Powered Autonomous Delivery Aircraft Release Procedures

1. PADA release must be at least 200 feet away from the center of the runway, measured parallel to the runway.
2. Teams must release the PADA at an altitude no greater than 50 ft.
3. Teams have as many passes as needed, as the PADA is released within four (4) minutes of throttle-up, lands within five (5) minutes of throttle-up.
4. The Primary Aircraft must come in for landing once the PADA is released.
5. A single PADA shall be successfully released during each flight attempt. Failure to release a PADA successfully and intentionally shall disqualify the entire flight attempt. A successful release is defined as:
    - Being within four (4) minutes of primary aircraft throttle-up
    - Complying with Section 8.15.1 and 8.15.2 as shown in Figure 8-1.
    - The PADA must attain stable flight after release.

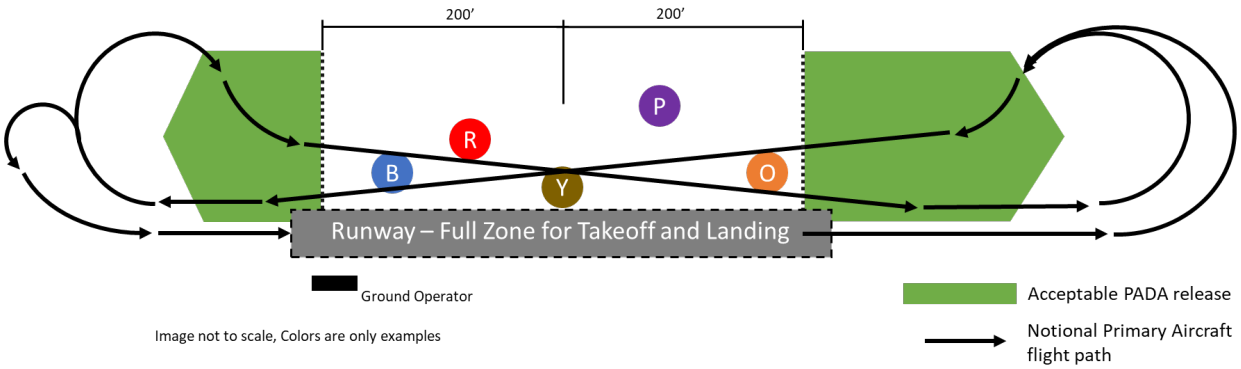


Figure 8-1 – Notional PADA Release Diagram. Not to scale.

8.16 Ground Transport Vehicle Demonstration Event Procedure

At the conclusion of all flight activities, before the award ceremony, teams shall have eight (8) minutes to demonstrate their GTV's ability to transport water in the following manner:

1. Each team will be set up in a designated area of the runway with sufficient separation from other teams to avoid interference.
2. On one side of the demonstration zone will be the unassembled GTV in the impound box and the team's main water storage container(s). Stationed on the other side of the zone (approx. 30 feet away) shall be the team's empty destination water storage container(s). Containers shall be positioned approximately as shown in Figure 8-2.
3. No more than three (3) team members may take part in the assembly and demonstration, including the GTV driver. Teams may split personnel between the start and destination sides of the area however they choose, but no team member may switch sides during the demonstration.
4. When the demonstration begins, the team shall assemble their GTV, load it with water from the main water storage container and navigate to the other side of the runway. Once the GTV has completely passed the finish line, the team member(s) on the other side of the runway shall unload the water into the destination storage container(s). Only water successfully delivered by the GTV within the time limit shall be measured for score.
5. Teams may handle the water storage containers, but neither the main nor destination water storage containers may be moved during the demonstration.
6. Multiple trips across the demonstration zone are allowed.
7. Team members on the starting side may only refill the GTV after it has completely left the demonstration zone.
8. The GTV may be autonomous or manually controlled. If the team controls the GTV via a transmitter when it is within the demonstration zone, the GTV shall be considered manually controlled for the entirety of the demonstration. Teams may touch, control, or manipulate an autonomous GTV when it is outside of the demonstration zone and the GTV shall still be considered autonomous. Touching the GTV while it is within the demonstration zone is prohibited under all circumstances.
9. Obstacles will be placed in the demonstration zone approximately as shown in Figure 8-2. The obstacles may be up to three (3) inches in height.

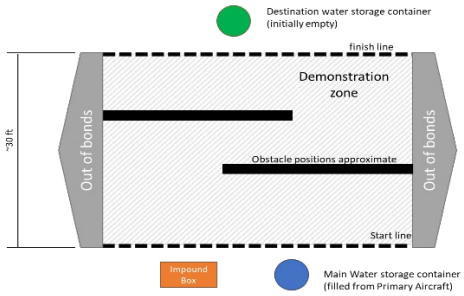


Figure 8-2: Notional Diagram of GTV Demonstration Event. Not to Scale.

8.17 Advance Class Scoring

To participate in the flight portion of the competition, each team is required to have submitted AND received a score for both Design Report and Oral Presentation.

The team's Final Flight Score (FFS) is the sum of the team's top three (3) flight scores achieved during competition (FS_1, FS_2, and FS_3) and the GTV event score. Teams receive points based on the water the primary aircraft successfully carries each flight and a flat score every time a PADA successfully lands in the designated landing zone, with a bonus for distance to the center derived from the team's predictions. Finally, teams who deliver enough parts via PADAs to assemble a working GTV will have the opportunity to score points by transporting water carried previously by the primary aircraft in a ground demonstration.

Scoring Equation:

$$Final\ Flight\ Score = FS_1 + FS_2 + FS_3 + GTV$$

Where:

$$FS = Flight\ Score = W_{Payload} + 8 * (Z_{PADA} + B_{PADA})$$

$$GTV = Ground\ Score = \frac{A_{GTV} * W_{delivered}}{4}$$

$$B_{PADA} = PADA\ Landing\ Bonus^{*} = 5 * \left(\frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{d^2}{2\sigma^2}}\right)$$

**Note, this is the normal probability density function with mean of 0*

$W_{payload} = Water\ (lbs)\ Successfully\ Flown$

$W_{delivered} = Total\ Water\ (lbs)\ Delivered\ by\ GTV\ During\ Demonstration$

$\boldsymbol{A_{GTV} = GTV\ Autonomy\ Multiplier: 5\ if\ autonomous, 3\ if\ manual}$

$Z_{PADA} = PADA\ Zone\ Multiplier: 2\ for\ random, 1\ for\ static$

$d = Distance\ of\ PADA\ to\ center\ of\ landing\ zone, rounded\ down\ to\ nearest\ ft$

$\sigma = Team\ supplied\ Standard\ Deviation\ from\ TDS\ (ft, \min of\ 1)$

Penalty Points

Penalty points assessed during competition are deducted from a team's overall score.

9 MICRO CLASS DESIGN REQUIREMENTS

The Micro Class objective is to challenge students to design a small, all electric aircraft to overcome conflicting design and performance requirements. Teams must maximize scoring for short takeoff and liquid payload, while minimizing penalties for wingspan and empty weight.

9.1 AIRCRAFT DIMENSION REQUIREMENTS

Micro Class aircraft are not limited to a maximum planform wingspan.

9.2 AIRCRAFT SYSTEMS REQUIREMENTS

Propulsion Requirements

Micro Class aircraft are restricted to electric motor propulsion only.

Propeller and Gearbox

Gearboxes where the propeller RPM differs from the motor RPM are allowed. Multiple motors, multiple propellers, propeller shrouds, and ducted fans are allowed.

Aircraft Propulsion System Battery

Micro Class aircraft must use Lithium Polymer batteries. Micro class batteries are allowed to be a maximum of four (**4**) cells.

Gyroscopic Assist

Gyroscopic assist and other forms of stability augmentation are allowed in Micro Class.

Power Limiter

Micro Class aircraft must use a 2021 or newer, 450-watt power limiter from the official supplier as described in Section 2.19.

9.3 PAYLOAD REQUIREMENTS

Types of Cargo

Micro Class payload shall consist of liquid water. Frozen water is prohibited.

Payload Container Requirements

Micro Class aircraft shall have a single Payload Container for carrying liquid water with the following additional requirements:

1. Payload container shall be fully enclosed with a minimum of two (2) sealable holes.
2. The first hole shall be on top of the payload container for filling.
3. The second hole shall be used for unloading liquid water from the payload container.
4. Payload container must have a minimum volume of 67 fluid ounces. Teams must consider the ability to quickly drain all liquid water as a timed activity.
5. Event organization reserves the right to inspect team's Payload Container.

9.4 PAYLOAD UNLOADING

To achieve a successful flight score, teams must use gravity to demonstrate the ability to drain liquid water from the payload container within one (1) minute without applying

external forces on the payload container. This demonstration will take place at the weigh station after each successful flight. The demonstration will begin with the aircraft configuration unchanged from the most recent successful flight.

This is a timed activity and shall be performed by no more than two (2) team members.

Only liquid water successfully unloaded from the aircraft will be weighed and recorded for scoring that flight.

9.5 MICRO CLASS AIRCRAFT TAKE-OFF

A Micro Class team will have one (1) take-off try per flight attempt.

The Micro Class take-off performance scoring equation determines the team's flight score. The take-off performance is determined using four (4) distance limits of 10 ft, 25 ft, 50 ft, and 100 ft. Each take-off distance limit will earn a multiplier for the team's flight score.

Any take-off beyond 100 ft will disqualify the flight attempt.

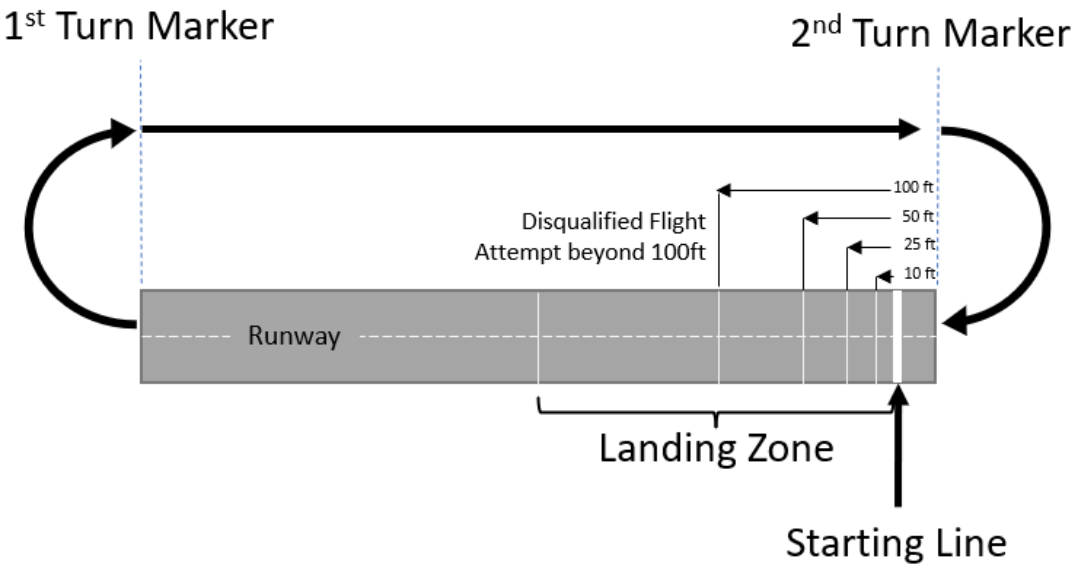


Figure 9-1 – Notional Micro-Class Flight Circuit

9.6 MICRO CLASS FLIGHT SCORING

To participate in the flight portion of the competition, each team is required to have submitted AND received a score for both Design Report and Oral Presentation.

The team's Final Flight Score (FFS) is the sum of the team's top three (3) flight scores achieved during the competition (FS_1, FS_2, and FS_3).

Scoring Equation:

$$Final\ Flight\ Score = FSS = FS_1 + FS_2 + FS_3$$

Where:

$$Flight\ Score = FS = 3 * W_{Payload} * M + Z$$

$$M = \frac{11}{\left(W_{Empty} - 1\right)^4 + 8.9}$$

$$Z = B_{Takeoff} - S^{1.5}$$

$W_{Payload} = Payload\ Weight\ (lbs)$

$W_{Empty} = Empty\ Weight\ (lbs)$

$S = Wingspan\ (ft)$

$$B_{Takeoff} = \begin{cases} 20 & 0 \leq x \leq 10\ ft \\ 15 & 10 < x \leq 25\ ft \\ 9 & 25 < x \leq 50\ ft \\ 0 & 50 < x \leq 100\ ft \end{cases}$$

Penalty Points:

Penalty points assessed during competition are deducted from the team's overall score.

APPENDIX A - STATEMENT OF COMPLIANCE

Certification of Qualification

Team Name _____ Team Number _____

School _____

Faculty Advisor _____

Faculty Advisor's Email _____

Statement of Compliance

As faculty Adviser:

_____ (Initial) I certify that the registered team members are enrolled in collegiate courses.

_____ (Initial) I certify that this team has designed and constructed the radio-controlled aircraft in the past nine (9) months with the intention to use this aircraft in the 2024 SAE Aero Design competition, without direct assistance from professional engineers, R/C model experts, and/or related professionals.

_____ (Initial) I certify that this year's Design Report has original content written by members of this year's team.

_____ (Initial) I certify that all reused content have been properly referenced and is in compliance with the University's plagiarism and reuse policies.

____ (Initial) I certify that the team has used the Aero Design inspection checklist to inspect their aircraft before arrival at Technical Inspection and that the team will present this completed checklist, signed by the Faculty Advisor or Team Captain, to the inspectors before Technical Inspection begins.

_____ _____

Signature of Faculty Advisor Date

_____ _____

Signature of Team Captain Date

Note: A copy of this statement needs to be included in your Design Report as page 2 (Reference Section 4.3)

APPENDIX B - APPEALS

Team Name	
Team Captain	
Collateral Points	*All appeals will require the team to post twenty-five (25) points as collateral. If the appeal is successful and the action is reversed, the team will not forfeit the twenty-five (25) collateral points. If the appeal is overruled, the team will forfeit the twenty-five (25) collateral points* Collateral Points: 25 Sign if Agree: _____
Reason for this Appeal	
Rule Reference	*List the section(s) in the official rule that is (are) in conflict with the action(s) taken by competition official* Section:_____ Section:_____ Section:_____ Section:_____
Desire outcome	

APPENDIX C – DAS, FPV, RADIO FREQUENCY REQUEST FORM

Advanced Class teams must fill out and submit this document to Glennsaefreq@gmail.com

Frequencies will be assigned as a group number in order of receipt, and teams will receive confirmation via email. Conflicts will be resolved via follow-up communication with teams.

If the transmitter is spread-spectrum, please indicate and restrict each choice to a three whole-number range.

All teams should be prepared to make adjustments at the competition.

COMPETITION (EAST/WEST)	
TEAM NUMBER	
SCHOOL NAME	
TEAM NAME	

	MAKE / MODEL
PRIMARY AIRCRAFT RC CONTROLLER	
PRIMARY AIRCRAFT RC RECEIVER	
PADA OVERRIDE RC CONTROLLER	
PADA OVERRIDE RC RECEIVER	

SYSTEM	TRANSMITTER MANUFACTURER AND MODEL	FREQUENCY CHOICE (PLEASE FILL OUT ALL THREE)			WATTAGE
		FIRST	SECOND	THIRD	
FPV					
DAS					
OTHER					