2024-25 Design, Build, Fly Rules

Summary

The AIAA through the Applied Aerodynamics, Aircraft Design, Design Engineering and Flight Test Technical Committees and the AIAA Foundation invites all university students to participate in the Textron Aviation/Raytheon Student Design, Build, Fly Competition. The contest will provide a real-world airplane design experience for engineering students by giving them the opportunity to validate their analytic studies.

Student teams will design, fabricate, and demonstrate the flight capabilities of an electric powered, remote-controlled airplane that can best meet the specified mission profile. The goal is a balanced design possessing good flight handling qualities and practical and affordable manufacturing requirements while demonstrating high vehicle performance.

To encourage innovation and maintain a fresh design challenge, the design requirements and performance objectives are updated for each new contest year. The changes provide new design requirements and opportunities, while allowing for application of technology developed by the teams from prior years.

Check the rules package carefully as items and approaches that were legal in past years may not be legal for this contest year. Only the contents of this year's Rules package along with the current FAQ and Q&A documents hold bearing on the requirements and/or allowances for the current contest year.

NOTE: Items in the rules that are critical to the safety and execution of the competition or are new are highlighted in RED text. Please take note of these requirements and rules.

It is the responsibility of the teams to know and follow all provided rules, the FAQ and Q&A, and all contest day briefings.

Cash prizes are **$3000** for 1st, **$2000** for 2nd and **$1500** for 3rd place. The winning team(s) may be invited to present their design at AIAA's AVIATION Forum. The team with the best Report Score will receive a **$100** prize from the Design Engineering Technical Committee.

General Information

Team Requirements:

All team members (except for a non-student pilot) must be full time students at an accredited University or College and student members of the AIAA. Team members may include graduate students. At least 1/3 of the team members must consist of freshman, sophomores or juniors (below senior year, for non-four-year programs). The pilot must be an AMA (Academy of Model Aeronautics) member. Teams may use a non-university member for the pilot if desired. Qualified, volunteer pilots will be available at the contest on an as-available basis to assist teams who are unable to have their pilot attend.

There is no set requirement for the number of students that must attend the fly-off. It is preferred, but not required, for the team advisor or responsible faculty member to attend.

Team members may be updated/changed at any time during the contest but must always comply with the 1/3 rule. Following the initial team roster submitted with the contest entry, a "One Time" update to the official team roster may be submitted with the Design Report in February.

Each educational institution may submit one (1) team entry.

For schools with multiple campuses in different cities each campus will be considered as a separate entity.

Two or more schools may combine to submit a single entry.

Schools which already have an entry may not have additional students from their school participate as members of a team from a different (shadow) school.

Sponsorship:

Teams may solicit and accept sponsorship in the form of funds or materials and components from commercial organizations. All design, analysis, major component fabrication and assembly of the contest entry airplane is the sole responsibility of the student team members.

Communications:

The contest administration will maintain a website containing the latest information regarding the contest schedules, rules, and participating teams. The contest web site is https://www.aiaa.org/dbf

Questions regarding the contest, schedules, or rules interpretation may be sent to the contest administrator by email at: director@aiaadbf.org

Please note that rules interpretation questions will not be answered by e-mail until after the entry date (when all participant e-mail addresses are known), so that all teams will have equal access to all rules and information. Questions received prior to the entry deadline will not be answered and must be resubmitted after the entry deadline. Official questions with answers received following the entry submission date will be posted on the website **Q&A** and delivered by email to all teams.

The DBF Organizing Committee will utilize social media as an additional means of communicating with the teams during the contest weekend only. This will NOT be a means of communicating rules, FAQ's, Q&A, protests, etc., but only used in case of emergencies, weather delays or contest weekend schedule updates. Additional information will be included in the contest information sheet to be sent out to the registered teams prior to the fly-off.

Flight Line and Order:

A flight order list will be generated and emailed to the teams on the Wednesday prior to the fly-off weekend. Teams will always rotate in this order. The flight order will be repeated continuously.

The flight order list will carry over from Thursday to Friday, Friday to Saturday, and Saturday to Sunday at whatever spot in the rotation it leaves off. The flight order list is used for all queues during the contest. These queues include, but are not limited to Tech inspection, Flight Line Missions, and Ground Missions. Note that the Organizing Committee reserves the right to open up any of the queues to first-come-first-served if no teams come when called or return to the flight order if lines begin to form. This will be done at the sole discretion of the Organizing Committee.

Each team's position in the flight order will be determined from their **Total Report Score**, the highest report score goes first.

Report scores will be available following the pilot briefing at the start of the contest (they will not be included with the flight order e-mail).

There will be staging box positions near the flight line.

If you are not ready to enter a staging box when your rotation number comes up, you will miss (forfeit) your opportunity for that rotation.

Note: It is each team's responsibility to monitor the notifications from the scoring table in order to respond if ready. Teams MUST Check-In with the scoring table before proceeding to the flight line. A contest official will be available to help teams enter the staging box.

If you choose to leave the staging box for any reason, that is still considered a flight attempt, and you may not attempt another flight until your turn comes up again in the rotation order.

Flight Course:

The orientation (direction) of the flight course will be adjusted based on the prevailing winds as determined by the Flight Line Judge. The flight course will be positioned to maintain the greatest possible safety for personnel and facilities. The nominal flight course is shown in Figure 1 below.

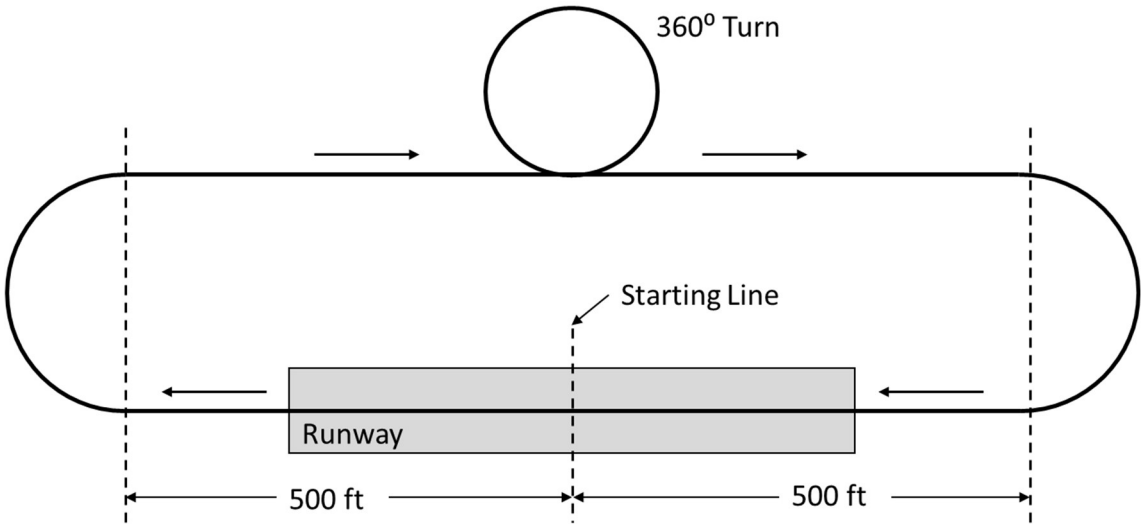

Figure 1. Course Layout

Protest Procedure:

Submitting a protest is a serious matter and will be treated as such. Teams may submit a protest to the Contest Administration at any time during the competition. Protests MAY NOT be submitted after the conclusion of the competition. Protests must be submitted in writing (Hard Copy) and signed by the registered team advisor; designees are not allowed for protest submissions. If the team advisor is not present, he or she may send a signed copy by electronic method to the team for them to present. Electronically submitted protests must be a printed hard copy and have the advisor's signature. A phone number where the advisor may be contacted must be provided. Protests may be posted for review at the decision of the administration.

Protests and penalties (up to disqualification from the contest for deliberate attempts to misinform officials, violate the contest rules, or safety infractions) will be decided by the Contest Administration. Protests submitted but not upheld by the judges may be given a penalty of the loss of one flight score to the team submitting the protest. The decision of the Contest Administration is final.

Teams may only protest events involving their own team. Protests against other teams or actions not specifically involving their own team will not be accepted.

Sportsmanship:

All teams and students participating in DBF are expected to uphold the highest standards of sportsmanship during the competition and abide by the AIAA Code of Ethics (https://www.aiaa.org/about/Governance/Code-of-Ethics). Attempts to intentionally violate the rules or negatively impact the performance of other teams will not be tolerated. Penalties for violations will be decided by the Contest Administration and may range from a warning to a loss of flight score up to disqualification from the current and future competitions.

Schedule

Entries:

The entry period OPENS 15 October at 8AM (0800) **US Eastern Time**. No entries will be accepted before that time. A completed entry must be RECEIVED by 5 PM (1700) **US Eastern Time** on 31 October. Entries will be collected through the AIAA Online Submission System.

Proposals and Team Rosters must be submitted as part of the entry process. Proposals and Team Rosters will not be accepted outside of the online submission system.

Be sure to include ALL required information requested by the online submission. Once submitted, corrections to the entry, including any corrections or updates to the Proposal, will not be accepted.

All team members must have a valid AIAA Student Membership. Membership numbers of all team members must be submitted with the team rosters. You may join at any time by going to the AIAA Student Membership website. Membership numbers are provided instantly upon payment of membership fees.

Incomplete entries will not be accepted.

It is the team's responsibility to make sure the e-mail contact addresses they supply remain active during the entire period from entry to the close of the competition as e-mail will be the primary means to provide information and updates. Do not use an internal team correspondence e-mail list server as your point of contact e-mail address.

An entry is not complete until the "Save and Finalize" function is selected in the online submission system and confirmed.

Proposal:

Proposals will be submitted using the online system.

The proposals will be scored as defined in the proposal requirements section. The top 110 proposals plus ties will be invited to submit design reports and potentially become eligible for the fly-off. Teams will be notified no later than 22 November if their proposal has been accepted.

Proposals submitted by email will not be accepted.

Proposals will be judged "as received". No corrections/additions/changes will be allowed by the organizers so check your proposals carefully before submitting them. Once a Proposal is submitted, no changes are allowed.

Submission of Proposals is electronic only. The details for the electronic format and submission are at the end of the proposal section in this rules document.

Design Report:

Design Reports will be submitted using the online system.

The design report submission period OPENS 1 February at 8AM (0800) **US Eastern Time**. The design report must be submitted by 5 pm (1700) **US Eastern Time** on 21 February 2025.

The reports will be scored as defined in the design report requirements section. Reports submitted by email will not be accepted.

Reports will be judged "as received". No corrections/additions/changes will be allowed by the organizers so check your reports carefully before submitting them. Once a Report is submitted, no changes are allowed.

Submission of Reports is electronic only. The details for the electronic format and submission, including a requirement for an additional, separate configuration drawing, are in the report section in this rules document.

Contest Fly-off:

The contest fly-off is scheduled for 10 - 13 April 2025 and is anticipated to run from 10AM (1000) to 6PM (1800) on Thursday, 7AM (0700) to 6PM (1800) on Friday, 7AM (0700) to 6PM (1800) on Saturday and 7AM (0700) to 5PM (1700) on Sunday (local time). The Awards will be presented at 5:30PM (1730) on Sunday. All teams should plan their travel so that they may stay for the awards presentations on Sunday. A final contest schedule will be e-mailed to the teams prior to the contest date.

Tech inspections will begin on Thursday afternoon and will continue as required on Friday, Saturday and Sunday.

To help streamline the contest flow and maximize opportunities for each team to get their flights in, the Tech inspections will be conducted in the same order as the flight rotation (which is based on report scores) so that the first teams inspected will be the first teams in the flight queue. Teams may use the sequence to help estimate when they need to arrive at the contest site to make sure they do not miss their slot in the first tech inspection rotation.

PLEASE NOTE: All schedule deadlines are strictly enforced

All deadlines are based on when an entry or submission is **Received** (Save and Finalize) by Contest officials via the online submission system.

Late entries and proposals will **NOT** be accepted.

Late report submissions will **NOT** be accepted.

There is no allowance for computer, internet, or power outages by the submitter, or any other type of error beyond the control of the DBF Organizing Committee.

Teams which do not submit the required electronic report and additional configuration drawing will **NOT** be allowed to fly.

It is the team's responsibility to ensure that all deadlines are known, understood, and met.

Fly-off Site

The host for the competition will be Raytheon. The fly-off is planned to be held at the Tucson International Modelplex Park Association (TIMPA) in Tucson, AZ. Details on the contest site and schedule will be sent to registered teams 2 - 3 weeks prior to the flyoff. You can check on historical weather conditions at www.weatherbase.com or www.weatherunderground.com.

Teams are advised to check with their airlines on what materials they will be allowed to bring both to and from the contest site. Hazmat items like paints, thinners and glues may need to be purchased locally and PROPERLY disposed of following the contest. **NOTE: It is the team's responsibility to ensure that their airplane arrives at the fly-off location. Neither AIAA nor the corporate sponsors will assist in getting your airplane or materials to the fly-off location. Teams may hand carry their airplane, use a shipping company to have it delivered to their hotel, or use any other means of transportation that they feel is appropriate. But each team must coordinate all aspects of getting the airplane to the fly-off.

International Teams: Special travel information for non-US teams can be found on the DBF website.

[New This Year: All attendees to the DBF Fly-off will be required to register for the event. This is required to comply with AIAA attendance rules and regulations for forums and large events. There will be no charge for attendance. More information will be provided prior to the Fly-off.]

Mission and Vehicle Design

X-1 Supersonic Flight Program

The objective for this year is to design, build, and test an airplane to execute an X-1 Supersonic Flight Test Program, including the launch of an X-1 test vehicle.

General:

- The maximum airplane wingspan is 6 feet.
- Payloads:
  - Mission 1 – none.
  - Mission 2 – X-1 test vehicle and fuel tanks.
  - Mission 3 – X-1 test vehicle and fuel tanks.
  - The fuel tanks must be a commercially available beverage bottle of any size or shape with a screw on cap. The bottle cannot be modified in any way other than the removal of externally applied labels (except those required to verify bottle capacity in Tech Inspection) and the addition of external paint or decorations that do not alter the external shape of the bottle. The bottle must have a minimum capacity of 16 fluid ounces. For safety reasons, the bottles cannot be made of glass.
  - The fuel tanks may be filled with varying amounts of inert materials (water, sand, etc) for a total fuel weight to achieve a desired mission score per attempt.
  - The fuel tanks will be carried externally and internally, with no more than one fuel tank carried internally for any given mission. All external fuel tanks must be the same size, shape and brand of beverage bottle for all missions. Teams cannot mix different sizes or shapes of external fuel tanks. The internal fuel tank can be a different beverage bottle from the external fuel tanks **and there is no requirement on minimum capacity for the internal fuel tank**. The internal fuel tank is optional.
  - All external fuel tanks will be attached to the airplane using pylons that will securely attach the fuel tanks during all phases of flight – take-off, flight, and landing. The pylons must be removable and not a permanent feature of the airplane design.
  - The X-1 test vehicle is a glider capable of autonomous flight. The X-1 test vehicle will be launched from the airplane at an altitude of 200-400 feet above ground level (AGL).
  - To achieve bonus points for Mission 3, the X-1 test vehicle must transition to stable flight after release from the airplane, execute a 180 degree turn and then fly a descending pattern or orbit of the teams choosing until landing on the ground. The bonus points will be based on coming to rest inside one of the bonus boxes as shown in Figure 1. If the X-1 test vehicle lands outside of the bonus boxes, no bonus points will be awarded.
  - The X-1 test vehicle shall have flashing lights or strobes that come on after release from the airplane. It is up to each team to ensure the lights can be seen by the Flight Line Judge. If the lights come on before launch or the lights fail to come on after launch, no bonus points will be awarded.

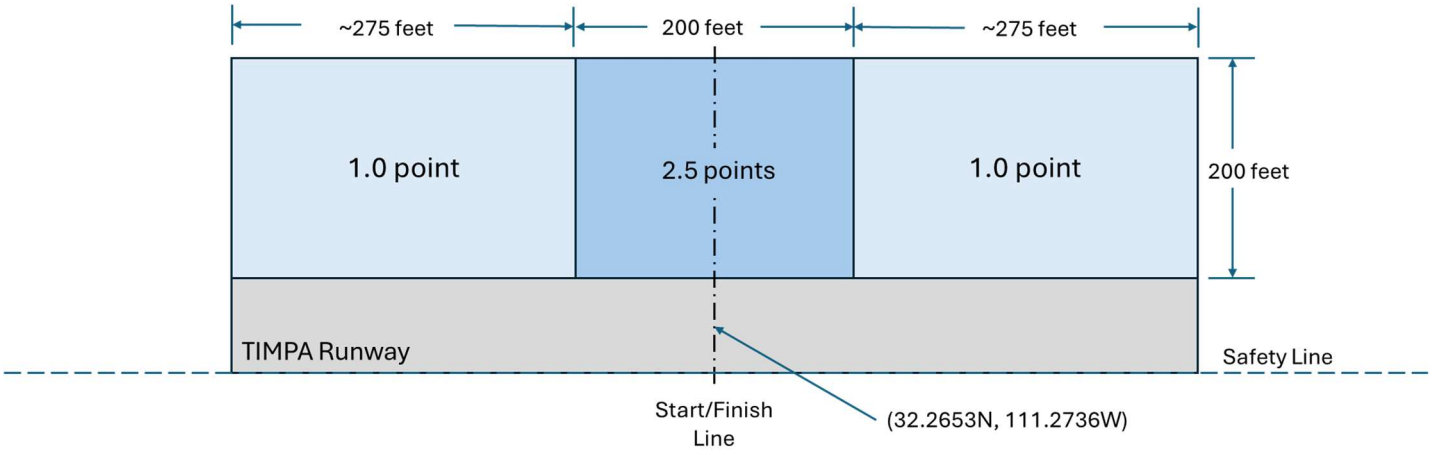

Figure 1. X-1 Test Vehicle Bonus Box Layout.

- After the X-1 test vehicle comes to rest in a bonus box, the lights/strobes must still be working (flashing) to achieve bonus points.
- The X-1 test vehicle flight control and navigation implementation is up to each team to determine and may include an autopilot/flight control with or without GPS on the X-1 test vehicle only. No Radio-Controlled receivers may be integrated into the X-1 test vehicle.
- The X-1 test vehicle shall have a maximum weight of 0.55 lbs. The actual weight of the X-1 test vehicle may be modified for each mission attempt up to the maximum allowable weight. Teams may bring multiple X-1 test vehicles to the competition to achieve a desired mission score for any mission attempt.

- The X-1 test vehicle must be carried underneath the airplane fuselage between the left and right external fuel tank. A bomb bay opening in the lower fuselage to clear the X-1 test vehicle fuselage and vertical stabilizer (if implemented) is allowed. If an opening is created, it must be closed for Mission 1 and at the start of the Ground Mission**. The cover(s) over the opening must be permanently attached to the airplane. The cover(s) cannot be permanently or temporarily removed to install the X-1 test vehicle.** There must be a minimum gap of 0.25 inches between any part of the airplane fuselage, wings or outer surface and X-1 test vehicle wings. The X-1 test vehicle must be secured to the airplane for all phases of flight – take-off, flight, and landing – other than intentional launch in Mission 3.
- The X-1 test vehicle must be capable of a commanded release from airplane via the pilot's transmitter.
- For Mission 2 and Mission 3, there must be a minimum of two external fuel tanks installed. For Mission 3, the fuel tanks may be empty.

Mission Sequence:

- The airplane must be capable of performing all required missions.
  - During Tech Inspection, the airplane must pass the wing tip load test in the flight configuration with the maximum designed takeoff weight, to include the heaviest weight payload declared and heaviest battery pack(s) to be flown.
  - The maximum load demonstrated will be recorded and cannot be increased after completing Tech Inspection.
- The Flight Missions must be flown in order.

    - A new mission cannot be flown until the team has obtained a successful score for the preceding mission.
    - The ground mission can be attempted at any time.
- The airplane must be flown in the same configuration for all three missions unless specifically cited herein.
- After successfully completing all three flight missions, teams will be allowed one additional attempt for both Mission 2 and Mission 3 to improve their score.
- After successfully completing the ground mission, teams will be allowed one additional attempt to improve their score.
- The airplane will be brought to the staging box with the propulsion battery pack(s) and payloads removed from the airplane. For Mission 1, the external fuel tank pylons **will not** be installed. For Mission 2 and Mission 3, the external fuel tank pylons **will be** installed prior to entering the staging box. The maximum number of pylons declared in tech inspection must be present for all Mission 2 and 3 attempts, regardless of the number of external fuel tanks flown for any given mission attempt.
- If you forget something you must leave the staging box and forfeit the flight attempt.
- Only the ground crew member, pilot, and observer may go to and enter the staging box or Ground Mission area.
- **The ground crew member is the only person who can touch the airplane while inside the staging box while preparing the airplane for flight.** One exception is to check balance using the wing tips with the aid of the observer or pilot.
- Prior to starting assembly of the airplane, the propulsion battery pack(s) will be inspected to verify it has been approved in Tech Inspection. For Mission 2, the total fuel tank weight will be measured and recorded. For Mission 3, the X-1 test vehicle weight will be measured and recorded.
- All assembly work on the airplane in the staging box or during the ground mission must be done with the airplane on its landing gear in the upright configuration. The airplane cannot be picked up, rotated or put in any position other than upright and on its landing gear during assembly, payload installation or flight controls checks. Blocks placed under the landing gear are allowed to provide adequate access to load the X-1 test vehicle from underneath. The blocks cannot exceed the height of the airplane fuselage from the ground while resting on its landing gear. Access panels are allowed to facilitate installation of payloads.
- The airplane assembly and payload installation and flight controls checks must be completed within the 5-minute window.
- There is no work allowed on the airplane after the 5-minute assembly and checkout time including connection of batteries, receivers, etc. The airplane must be ready to fly prior to being called to the flight line, less the installation of the arming fuse.
- The airplane will use ground rolling takeoff and landing. **There is no limit on take-off distance this year**.
- The airplane must complete a successful landing at the end of each mission for the mission to receive a score. A successful landing is outlined in the general mission specifications section below.

Flight Missions:

Mission 1: Delivery Flight

- There is no payload for this mission.
- The airplane will enter the staging box with the propulsion battery pack(s) removed.
- The ground crew member will install the battery pack(s) and prepare the airplane for flight within the 5-minute staging window.
- Teams must complete 3 laps within the flight window.
- There will be a 5-minute flight window for this mission.
- Time starts when the airplane throttle is advanced for the first take-off (or attempt).
- A lap is complete when the airplane passes over the start/finish line in the air (the landing is not part of the 5-minute time window).
- Must complete a successful landing to get a score.

Scoring:

M1 = 1.0 for successful mission.

Mission 2: Captive Carry Flight

- The payload for Mission 2 is the X-1 test vehicle and fuel tanks.
- A minimum of two externally mounted fuel tanks must be carried.
- The airplane will enter the staging box with the propulsion battery pack(s), fuel tanks and X-1 test vehicle removed. The staging box judge will weigh the fuel tanks and record the total weight on the score sheet.
- The ground crew member will install the battery pack(s), X-1 test vehicle and fuel tanks and prepare the airplane for flight within the 5-minute staging window.
- There will be a 5-minute flight window for this mission.
- The time to fly 3 laps within the 5-minute window will be recorded.
- The score will be a function of the time to fly 3 laps and total fuel weight.
- Time starts when the airplane throttle is advanced for the first take-off (or attempt).
- A lap is complete when the airplane passes over the start/finish line in the air (the landing is not part of the 5-minute time window).
- Must complete a successful landing to get a score.

Scoring:

M2 = 1 + [N_(fuel weight / time) / Max_(fuel weight / time] , where **Max_**(**fuel weight / time**) is the highest (**fuel weight / time)** score of all teams.

Mission 3: Launch Flight

- The payload for Mission 3 is the X-1 test vehicle and fuel tanks.
- A minimum of two externally mounted fuel tanks must be carried. External fuel tanks may be empty.

- The airplane will enter the staging box with the propulsion battery pack(s), external fuel tanks and X-1 test vehicle removed. The staging box judge will weigh the X-1 test vehicle and record the weight on the score sheet.
- The ground crew member will install the battery pack(s), X-1 test vehicle and two external fuel tanks and prepare the airplane for flight within the 5-minute staging window.
- There will be a 5-minute flight window for this mission.
- After completing the first lap or any subsequent lap, the X-1 test vehicle will be released after crossing the start/finish line and prior to executing the upwind turn. Each team will determine the number of laps flown prior to launching the X-1 test vehicle. The X-1 test vehicle must be launched to achieve a successful mission score.

[NOTE: The pilot or observer should confirm with the Flight Line Judge that the airplane is at the required altitude (200-400 feet AGL) before launching the X-1 test vehicle. Failure to do so will result in a failed mission attempt if the Flight Line Judge declares the launch was outside the required attitude.]

- The airplane must complete the full lap after launching the X-1 test vehicle within the 5-minute window prior to landing.
- The X-1 test vehicle must come to rest on the ground within the 5-minute flight window for any applicable bonus points to count. If the X-1 test vehicle comes to rest across the safety line shown in Figure 1, the mission attempt is a failure.
- The score will be a function the number of laps flown prior to launch of the X-1 test vehicle plus any bonus points (bonus box score / X-1 test vehicle weight).
- Time starts when the airplane throttle is advanced for the first take-off (or attempt).
- A lap is complete when the airplane passes over the start/finish line in the air (the landing is not part of the 5-minute time window).
- Must complete a successful landing to get a score.

Scoring:

M3 = 2 + [N_(# laps flown + (bonus box score / X-1 test vehicle weight)) / Max_(# laps flown + (bonus box score / X-1 test vehicle weight)] , where **Max_(# laps flown + (bonus box score / X-1 test vehicle weight)** is the highest (**# laps flown + (bonus box score / X-1 test vehicle weight)** score of all teams.

Ground Mission: X-1 Flight Test Program Demonstration

- The Ground Mission is a timed mission demonstration of the X-1 Flight Test Program. The demonstration includes conversion of a fleet bomber aircraft to the test program airplane, installation of all pylons and fuel tanks and the X-1 test vehicle and a ground demonstration of a successful launch of the X-1 test vehicle.
- The teams will enter the ground mission with the airplane without external fuel tank pylons, fuel tanks and X-1 test vehicle installed. The external fuel tanks may be empty for this mission. The propulsion battery is not part of the ground mission but flight controls will be verified at the completion of the mission.
- The ground crew member and a pilot may participate in the Ground Mission; only the ground crew member can touch the airplane and payloads.

- The mission will start with the airplane on its landing gear. The airplane may be on blocks as allowed in the staging box for access underneath. The airplane shall remain on its landing gear during all assembly and installation processes.
- Time will start when the ground mission judge says “GO”.
- The ground crew member will install all external pylons declared in Tech Inspection then say “STOP” at which time the ground mission judge will stop the clock and verify the number of pylons installed is correct.
- Time will re-start when the ground mission judge says “GO”.
- The ground crew member will then install all declared fuel tanks and the X-1 test vehicle and close and secure all access hatches, if implemented, then say “STOP”, at which time the ground mission judge will stop the clock and verify the number of fuel tanks installed is correct and the fuel tanks and X-1 test vehicle are properly installed and secured and all access hatches closed (if implemented).
- The pilot will verify all flight controls are working properly.
- The pilot will then release the X-1 test vehicle from the airplane. The ground crew member may place padding under the X-1 test vehicle prior to release.
- The ground mission judge will verify the lights come on the X-1 test vehicle after release and record the total mission time.

Scoring:

GM = [Min_(mission time) / N_(mission time] , where **Min_(mission time)** is the lowest **mission time** for all teams.

Airplane Requirements:

General

- The airplane may be of any configuration except rotary wing or lighter-than-air.
- No structure/components may be dropped from the airplane during flight. **An exception for this year is the X-1 test vehicle in Mission 3 only.**
- The airplane must be radio controlled with manual flight by the pilot. **No autopilots/flight controllers are allowed under any circumstances, even in manual mode. No onboard GPS systems are allowed.** Flight stabilization subsystems and rate gyros are allowed.
- No form of externally assisted take-off is allowed. All energy for take-off must come from the on-board propulsion battery pack(s).
- The airplane must be propeller driven and electric powered with an unmodified over-the-counter model electric motor. May use multiple motors and/or propellers. May be direct drive or with gear or belt reduction.
- Motors must be any commercial brushed or brushless electric motor.
- For safety, each airplane will use a commercially produced propeller/blades. The propeller can have folding blades. Teams may modify the propeller diameter by clipping the tip and may paint the blades to balance the propeller. No other modifications to the propeller are allowed. Commercial ducted fan units are allowed.

- You can change the propeller (diameter/pitch) for each flight attempt.
- The airplane and pilot must be Academy of Model Aeronautics (AMA) legal. This means that the airplane TOGW (take-off gross weight with payload) must be less than 55-lb, and the pilot must be a member of the AMA. All pilots must sign in and verify AMA membership.
- Since this is an AMA sanctioned event, the team must submit proof that the exact airplane being presented at Tech Inspection has been flown prior to the contest date to the technical inspection team. **Proof of flight is a video showing controlled straight and level flight and will be presented to the inspector when called to Tech Inspection. There are NO exceptions to this requirement.**
- The airplane must remain substantially the same as documented in the report (for example you cannot change a flying wing design to a conventional tail design). You may make small modifications to the design to improve flight performance after the report submission (one example would be changing a control surface size). The configuration drawing supplied in PDF form as described below in the Design Report section will be used to verify the airplane configuration during tech inspection.
- **The airplane must have an externally accessible SWITCH to turn on the radio control system. It cannot be internal or under a panel or hatch. An arming plug is NOT considered an acceptable switch. The radio control system switch must be separate from the propulsion system fuse & arming system.**

Batteries

- There can be a maximum of one battery pack connected to a propulsion system. A propulsion system consists of one battery, one externally accessible arming fuse, one or more electronic speed controllers (ESC), and one or more motors.
- **If the ESC has a Battery Eliminator Circuit (BEC), it MUST be disabled.**
- If more than one battery pack is implemented for a single purpose such as propulsion, the following rules apply:
    - All commercial battery packs must be identical (same manufacturer, part number, size, voltage, power, rating, etc).
    - Each battery pack must be independently connected to its own propulsion system. Batteries cannot be connected in series or parallel.
    - Each battery/propulsion system is required to have its own Arming Fuse.
- Teams may choose between NiCad/NiMH OR Lithium based batteries with the following provisions:
    - Teams may only use one battery type for propulsion.
    - Once a team completes tech inspection with a specific battery type, the team must use that battery type for the remainder of the competition.
    - **A separate battery is required for the Rx/Servo battery on the airplane. There is no restriction on the Rx/Servo and Transmitter battery type regardless of the propulsion battery type.**
    - **Individual battery packs cannot exceed the FAA limits for hand carry on commercial air flights of 100 Watt-hours (rated capacity x rated voltage) per battery pack and as further defined in:**

      https://www.faa.gov/hazmat/packsafe/lithium-batteries

    - **Propulsion power total stored energy cannot exceed 100 Watt-hours.**

- Battery packs must be properly labeled indicating cell chemistry.
- All battery disconnects must be "fully insulated" style connectors.
- **All battery packs must be un-altered and commercially procured as Commercial-Off-The-Shelf (COTS) battery packs. Custom battery packs will not be allowed.**
- The Manufacturer's Label stating the Battery Capacity (mAh), Voltage (V), and C-Rating must be clearly visible.
- **The maximum current rating for the Arming Fuse is 100 amps.**
    - If using lithium-based batteries, the maximum current rating for the fuse is the maximum continuous discharge current rating of the lithium battery pack (battery capacity X C-rating) up to 100 amps**.**
- Lithium batteries must be stored and charged in a commercially available, unaltered Lithium battery charging sack – the only time they can be out of the sack is for tech inspection or while in the airplane.

NOTE: It is the responsibility of each team to ensure compliance with all laws and regulations for shipping or hand-carrying batteries.

- Batteries may not be changed or charged during any mission attempt.
- There is no limit to total battery weight (only capacity).

Technical Inspection:

All airplanes, payloads, and required equipment will undergo a technical inspection by a designated contest tech inspector prior to teams being allowed to attempt a flight or ground mission. All decisions of the Tech inspector are final.

To speed up the tech inspection process, each team MUST present a paper copy of a signed Pre-Tech and First-Flight Certification when called to begin their on-site tech inspection. Teams may not begin the on-site tech inspection without a completed certification. The Pre-Tech and First-Flight Certification sheet will be provided to each team prior to the fly-off and made available on the contest website.

The Pre-Tech must be conducted by, and signed off by, a non-team member RC pilot or the team faculty advisor. The Pre-Tech will cover the same safety of flight requirements as the on-site tech inspection and will assist teams in making sure they are ready and able to pass the on-site tech inspection the first time. An expanded First-Flight requirement, which also must be signed off by a non-team member RC pilot or the team faculty advisor, requires demonstration of a complete flight including take-off, flying a minimum flight pattern, and landing in a pre-designated location without damage to the airplane. The non-team member RC pilot who signs the inspection and flight certifications may be the same as a team's non-student contest pilot.

Each team will also present their proof of flight video showing controlled straight and level flight to the inspector when called to Tech Inspection.

Airplane Staging:

- The airplane will enter tech inspection with pylons installed and all payload items removed.
- The fuel tanks will be the maximum number and maximum possible total weight the team intends to fly (Note: teams will not be allowed to fly with a quantity or weight greater than this after completing tech inspection but can fly with fewer tanks and less weight if they choose).
- If a team has more than one X-1 test vehicle, then all X-1 test vehicles will be brought to tech inspection.
- All batteries and battery packs must be inspected during tech inspection. Teams should bring all possible batteries for use over the full duration of the competition to tech inspection.

NOTE: Teams will be allowed to have additional batteries or battery packs inspected after passing tech inspection due to damage, real time power change requirements, etc. However, teams must follow the tech inspection queue or wait until tech inspection is open for all for additional battery inspections. Any team that uses batteries that have not passed a tech inspection will lose that flight attempt and cannot attempt any further flights until the batteries have passed inspection.

Safety inspections will include the following as a minimum:

Physical inspection of vehicle to ensure structural integrity:

1. Verify all components are adequately secured to the vehicle. All permanent fasteners shall incorporate a locking device in accordance with FAA CFR requirements, which is defined as a feature incorporated on the fastener which will prevent the loss of the fastener and retain the fastener in its proper installation. The locking devices on the fastener may be either friction (Examples include nylock nuts, bolts with nylon inserts or proper adhesive (LoctiteTM, superglue (cyanoacrylate adhesive (CA))) or nonfriction (Examples include cotter pins, R-clips, lock wire) types. No friction locking device may be used on any fastener subject to

rotation in operation unless a nonfriction locking device is used in addition. Clevises on flight controls must have an appropriate mechanical locking device to prevent their disengaging in flight.

2. Verify all hatches and access panels have a positive, mechanical latching method to assure it does not come loose in flight. Spring latches, fasteners, cotter pins, tape, etc are examples of acceptable methods. Magnets are not an acceptable latching method. Velcro may be an acceptable method depending on the implementation, but a secondary method may be required at the discretion of the technical inspector.
3. Verify propeller structural and attachment integrity.
4. Visual inspection of all electronic wiring to assure adequate wire gauges and connectors in use.
5. Radio range check with motor off and motor on.
6. Verify all controls move in the proper sense.
7. Check the general integrity of the payload system.

Structural verification:

The airplane will be lifted with one lift point at each wing tip to verify adequate wing strength (this is "roughly" equivalent to a 2.5g load case) and to check for vehicle cg location. Teams must mark the expected empty and loaded cg locations on the exterior of the airplane. Special provisions will be made at the time of the contest for airplanes whose cg does not fall within the wing tip chord. This test will be made with the airplane at its maximum payload and battery (combination) weight.

Radio fail-safe check:

All airplane radios must have a fail-safe mode that is automatically selected during loss of transmit signal. The fail-safe will be demonstrated on the ground by switching off the transmit radio. During fail-safe the airplane receiver must command:

- Throttle closed
- Full up elevator
- Full right rudder
- Full right aileron
- Full Flaps down

For airplanes not equipped with a particular control, then the tech inspector must be satisfied that the intended function of the fail-safe system will be carried out.

The radio Fail Safe provisions will be strictly enforced.

All airplane must have a mechanical motor arming fuse separate from the onboard radio Rx switch. This MUST be the contest specified "blade" style fuse. This device must be located so it is accessible by a crew member standing ahead of the propeller(s) for pusher airplanes, and standing behind the propeller(s) for tractor airplanes (i.e. the crew member must not reach across the propeller plane to access the fuse). The "Safety Arming Device" will be in "Safe" mode for all payload changes. The airplane Rx should always be powered on and the throttle verified to be "closed" before activating the motor arming switch. Fuses MUST be mounted on the outside of the airplane (they cannot be behind an access panel or door) and **MUST** act as the "safing" device. Note: The airplane must be “safed” (arming fuse removed) any time the airplane is being manually moved, or while loading/unloading payloads during the mission. The arming fuse must be removed anytime the airplane is in the hanger area.

The maximum current rating for the Arming Fuse is 100 amps.

- If using lithium-based batteries, the maximum current rating for the fuse is the **maximum continuous discharge current rating of the lithium battery pack (battery capacity X C-rating) up to 100 amps.**

General Mission Specifications and Notes:

- The airplane propulsion system(s) must be "safed" (fuse removed) during any time when crew members are preparing/handling the airplane.
- Maximum mission support crew is: pilot, observer, and ground crew.
- Observer and ground crew must be students. Only the pilot may be a non-student.
- The upwind turn will be made after passing the upwind marker. The downwind turn will be made after passing the downwind marker. Upwind and downwind markers will be 500 ft from the starting line. The airplane must be "straight and level" when passing the turn marker before initiating a turn.
- "Successful" Landing – The airplane must land on the paved portion of the runway. The airplane may "run-off" the runway during roll-out. The airplane may not “bounce” off the runway
- Airplanes obtaining “significant” damage during landing will not receive a score for that flight. Determination of “significant” is solely at the discretion of the Flight Line Judge.
- Flight altitude must be sufficient for safe terrain clearance and low enough to maintain good visual contact with the airplane. Decisions on safe flight altitude will be at the discretion of the Flight Line Judge and all rulings will be final.
- **All instructions from the Flight Line Judge must be followed IMMEDIATELY. Failure to do so may result in a loss of mission attempt or in the case of multiple or serious infractions, loss of future flight attempts.**
- Additional information is included in the FAQ (Frequently Asked Questions).

Reports

All material contained within all proposals and design reports must be original work of the teams or appropriately cited in the bibliography section of the report or in the footnotes of the proposal. All proposals and reports will be reviewed using standard AIAA tools. Any material that is found to be uncited and non-original work will be subject to a penalty as determined by the DBF Organizing Committee. Based on the severity, penalties can include points deducted from the proposal or report score up to a 100% reduction or full disqualification for the competition year.

Proposal:

[New This Year: The proposal score will be incorporated into the final team score as a percentage of the Total Report Score. Details can be found in the Scoring section of the Rules.]

Each team will submit a proposal as outlined below that will be judged and scored.

Examples of top scoring proposals from prior contest years are posted on the contest website. Note that the formatting and content may have changed from one year to the next. Prior year proposals may not reflect or meet the rules listed for the current year.

Note: Proposals must strictly adhere to the following requirements. Failure to meet requirements will result in penalties that range from score reduction to elimination from the contest.

Formatting Requirements:

- Proposals must be in PDF format. **Proposals that are not in PDF format will not be accepted.**
- Proposals must be one and one-half line spacing with a 10-pt Arial font recommended. Text, tables, and figures should be clear and readable for the judges. The proposals will be assessed for format and readability at the judges' discretion.
- Proposals must have the University name on the first page.
- Absolute maximum page count for the proposal is **6** pages, the PDF reader "pages" value will be used as the official page count.
- **Proposals exceeding the maximum page count will not be accepted.**
- Proposal PDF must be formatted as 8.5" x 11" pages.

Submission Requirements:

Each team must provide an electronic copy of their proposal as outlined below to the online Submission site.

- Electronic proposal must be named: "2025DBF_[university name]_PROPOSAL.pdf" .
  - University name should not be an acronym.
  - Universities with multiple campuses should specify which campus in the university name.
- Electronic proposal must be a single file with all figures/drawings included in the proper sequence in PDF format.
- Electronic proposals should have all figures compressed to print resolution to minimize file size.
- Electronic proposals must be less than 20 MB in size.

Proposals exceeding the file size will incur a 10-point penalty.

Summary of Proposal Non-Compliance Penalties

Requirement	Penalty
Must be in PDF format	Rejection (Not Accepted)
Maximum page count of 6 pages	Rejection (Not Accepted)
File size (</= 20 MB)	10 points

Scoring:

Proposals will be scored on a 100-point basis following the guidelines outlined below.

All information used for scoring must be in the outlined sections. **Content that is out of sequence will be treated as missing and scored accordingly.**

ALL items requested below should be present, easy to locate and identify, well documented and in the correct section for full scoring. Note that all proposals are assessed relative to each other so that simply addressing each of the sections below may not be sufficient for full credit. Proposals will be assessed on how well they communicate the required information given the size and length constraints.

Proposal Scoring Rubric:

All section scores include format, completeness and readability.

Executive Summary (**5** points):

- Objective Statement.
- Planned approach to achieve all objectives.
- Includes main points from subsequent sections.

Management Summary (**20** points):

- Describe the organization, the roles of each team and individual skill sets required.
- Organization chart (by team/function, individual names are not required for the proposal).
- Schedule / Major Milestone chart.
- Budget (not only for expected materials and manufacturing of the airplane, but for travel to the competition site and any other expenses associated with the competition).

Conceptual Design Approach (**55** points):

- Decomposition of mission requirements into sub-system requirements.
- **Trade Studies conducted with results.**
- Preliminary design / sizing results; concept sketch, if available (does not have to be representative of the final design).

- Sensitivity Study of Design Parameters.
- **Description of design approach for each mission including initial targets for contest specific scoring parameters such as payloads, weights, and/or lap times.**

Manufacturing Plan (**10** points):

- Preliminary manufacturing flow.
- Describe critical processes or technologies required.

Test Planning (**10** points):

- Component and ground test plan.
- Flight test plan.

Design Report:

Each team will submit a design report as outlined below that will be judged and scored.

Examples of winning team design reports from prior contest years are posted on the contest website. Note that the formatting and content has changed from one year to the next. Prior year reports may not reflect or meet the rules listed for the current year.

Note: Reports must strictly adhere to the following requirements. Failure to meet requirements will result in penalties that range from score reduction to elimination from the contest.

Formatting Requirements:

- Reports must be in PDF format.

Reports that are not in PDF format will not be accepted.

- Reports must be one and one-half line spacing with a 10-pt Arial font recommended. Text, tables and figures should be clear and readable for the judges. The reports will be assessed for format and readability at the judges' discretion.
- Reports must have the University name on the cover page.
- Absolute maximum page count for the report is 60 pages, the PDF reader "pages" value will be used as the official page count.

Reports exceeding the maximum page count will incur a 10-point penalty for each additional page.

- Report PDF must be formatted as 8.5" x 11" pages.
- May use 11" x 17" pages for the drawing package.
- An additional stand-alone configuration drawing must be submitted along with the report file. See description below in the Submission Requirements section.

Submission Requirements:

Each team must provide an electronic copy of their design report as outlined below to the online Submission site.

- Electronic report files must be named: "2025DBF_[university name]_DESIGN_REPORT.pdf".

- Electronic report must be a single file with all figures/drawings included in the proper report sequence in PDF format.
- Electronic reports should have all figures compressed to print resolution to minimize file size.
- Electronic reports must be less than 20 MB in size.

Reports exceeding the file size will incur a 10-point penalty.

Stand Alone Configuration Drawing Requirements:

- In addition to the drawings included within the design report, an additional, separate file with a one page configuration drawing formatted to fit 8.5" x 11" paper must be submitted with the report for confirmation of the basic configuration. Note that this page DOES NOT count toward the report total page count)
- The configuration drawing shall include the following configuration items as a minimum:
    - Wing configuration
    - Propulsion/propellor location(s)
    - Tail configuration
    - Landing gear configuration (tricycle vs tail-dragger for example)
- The configuration drawing must be in the format shown in Figure 7 and must include a top, side, front and isometric view.
- The configuration drawing file must be named: "2025DBF_[university name]_CONFIG.pdf".
    - University name should not be an acronym.
    - Universities with multiple campuses should specify the campus in the university name.
- The university name shall be clearly shown on the drawing.
- The configuration drawing file is limited to 5 MB in size.

Configuration drawings that do not contain the configuration items above or are in the format shown in Figure 7 or meet the file size requirement will incur a 10 point penalty against the design report score.

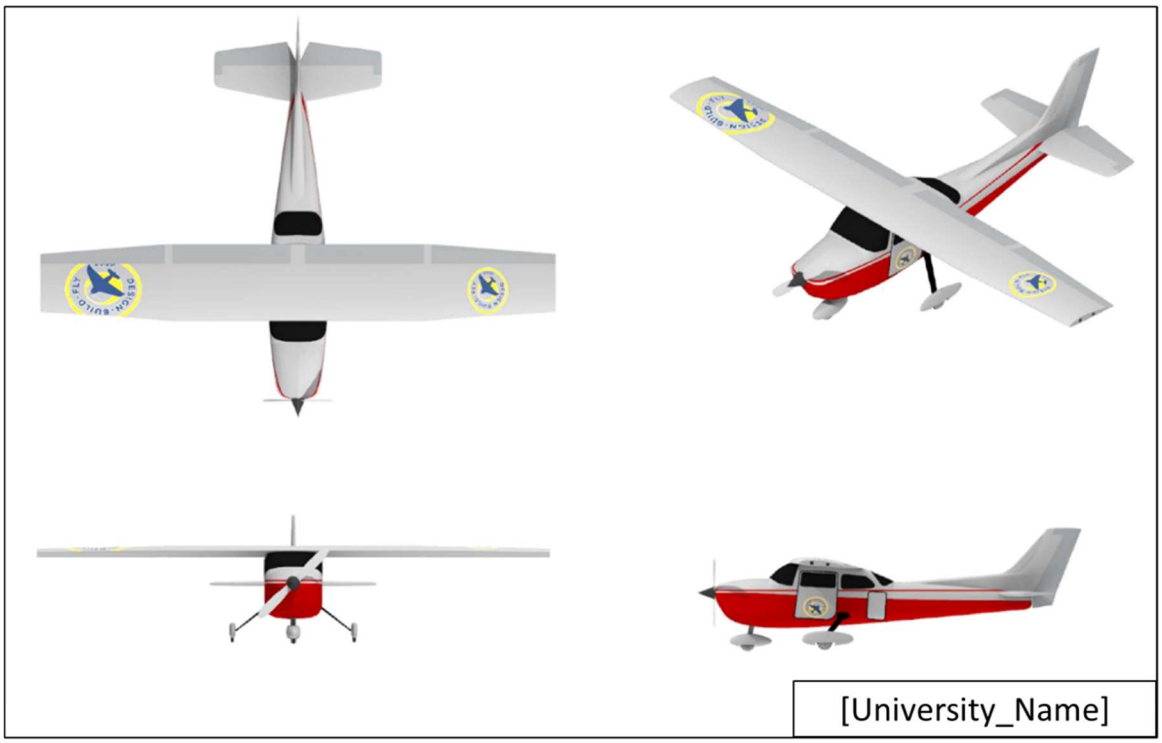

Figure 7. Configuration Drawing Format and Content.

Summary of Report Non-Compliance Penalties

Requirement	Penalty
Must be in PDF format	Rejection (Not Accepted)
Maximum page count of 60 pages	10 points per additional page
Report file size (</= 20 MB)	10 points
Configuration drawing content, format or size (</= 5 MB)	10 points

Scoring:

Reports will be scored on a 100-point basis following the guidelines outlined below.

All information used for scoring must be in the outlined sections. **Content that is out of sequence, including the drawing package, will be treated as missing and scored accordingly.**

ALL items requested below should be present, easy to locate and identify, well documented and in the correct section for full scoring. Note that all reports are assessed relative to each other so that simply addressing each of the sections below may not be sufficient for full credit. Reports will be assessed on how well they communicate the required information given the size and length constraints.

Design Report Scoring Rubric:

All section scores include format, completeness and readability.

Executive Summary (5 Points):

- Maximum of 1 page. If exceeded, score as 0 points.
- Summary description of selected design and why it best meets the mission requirements.
- Main points from subsequent sections.
- Document the performance/capabilities of your system solution.

Management Summary (5 Points):

- Describe the organization of the design team.
- Chart of design personnel and assignments areas.
- Milestone chart showing planned and actual timing of major elements.

Conceptual Design (15 Points):

- Describes mission requirements (problem statement).
- Translate mission requirements into sub system design requirements.
- Present a scoring sensitivity analysis.
- Review solution concepts/configurations considered.
- Describe concept weighting and selection process and results.

Preliminary Design (20 Points):

- Describe design/analysis methodology.
- Document design/sizing trades.
- Describe/document methodology for prediction of airplane performance (include capabilities and uncertainties).
- Provide estimates of the airplane lift, drag and stability characteristics and method of prediction.
- Provide estimates of the airplane mission performance.

Detail Design (15 Points + 15 Points for Drawing Package):

- Document dimensional parameters of final design.
- Document structural characteristics/capabilities of final design.
- Document systems and sub-systems selection/integration/architecture.
- Document Weight and Balance for final design.
- Must include Weight & Balance table empty and with each possible payload/configuration.
- Document flight performance parameters for final design.
- Document mission performance for final design.
- Drawing package:
    - Configuration drawing with dimensions of all configurations.

- Structural arrangement drawing.
- Systems layout/location drawing.
- Payload(s) accommodation drawing(s).

Manufacturing Plan (5 Points):

- Document the process selected for major component manufacture.
- Manufacturing processes investigated and selection process and results.
- Manufacturing milestones chart: plan and actual.

Testing Plan (5 points):

- Describe all major ground and flight tests performed.
- Objectives and schedule for each.
- Data to be collected and how applied.
- Test and flight check lists.

Performance Results (10 Points):

- Describe the demonstrated performance of key subsystems following execution of testing plan.
- Compare test results to predictions and explain any differences and improvements made.
- Describe the demonstrated performance of your complete airplane solution.
- Compare test results to predictions and explain any differences and improvements made.

Bibliography (5 Points):

- Must include list of all published works referenced in the text must be present in this section.
- Any material taken from a published source in all previous sections must have a numerical subscript corresponding to the appropriate citation in this section.
- References should appear in numerical order.
- Format should match AIAA provided guidelines:

https://www.aiaa.org/publications/journals/reference-style-and-format

Scoring

In the event that, due to time or facility limitations, it is not possible to allow all teams to have the maximum number of flight attempts, the contest committee reserves the right to ration and/or schedule flights. The exact determination of how to ration flights will be made on the contest day based on the number of entries, weather, and field conditions. In the event of a tie, Total Report Score will take precedence over Flight Score as a tiebreaker.

Judging:

Students must design, document, fabricate, and demonstrate the airplane they determine to be capable of achieving the highest score on the specified mission profile(s). Mission scores will be based on the demonstrated mission performance obtained during the contest.

Each team must also submit a written Proposal and Design Report. A maximum of 100 points will be awarded for each report. The overall team score is a combination of the Proposal and Design Report score and Total Mission Score plus a Participation Score. The team with the highest overall team score will be declared the winner. Scores will be FINAL 7 working days after the completion of the contest. This period will allow for review of the scores in a timely fashion following the contest.

All submitted reports are the property of AIAA, Textron Aviation and Raytheon and may be published or reproduced at their discretion.

Units of Measure:

The units of measure for scoring will be based on the US English system. All times or physical measurements will be rounded to the number of decimal places shown in Table 1. Conventional rounding will be implemented (<0.50 --> round down, >= 0.50 --> round up).

Units of Measure and Number of Decimal Places		
Item	**Unit of Measure**	**Decimal Places**
Time	Seconds (s)	2 (e.g. X.XX)
Length	Inches (in)	2 (e.g. X.XX)
Weight	Ounces (oz)	2 (e.g. X.XX)
	Pounds (lbs)	2 (e.g. X.XX)

Competition Score:

Each team's overall score will be computed from their Total Report Score, Total Mission Score, and Participation Score using the following formula:

Competition Score = Total Report Score * Total Mission Score + P

Total Report Score = 0.15 x Proposal Score + 0.85 x Design Report Score

P = Participation Score as follows:

P	Participation
1	Attending the Fly-off
2	Completing Tech Inspection
3	Attempting a Flight Mission

Ties in competition score will be ranked by highest Total Report Score. The Total Mission Score will be computed from the individual Flight Mission and Ground Mission Scores using the following formula:

Total Mission Score = M1 + M2 + M3 + GM