



2023-24 Design, Build, Fly Rules



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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 hi-lighted 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@aiaadb.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 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 **written 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 rotation sequence 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 to personnel and facilities. The nominal flight course is shown in Figure 1 below.

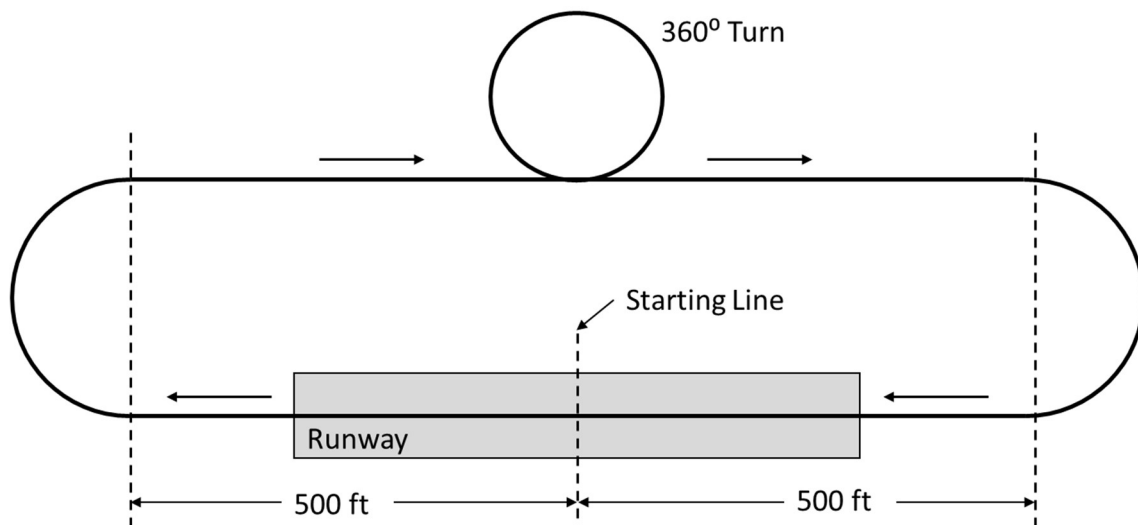


Figure 1. Course Layout

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 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 by electronic method a signed protest to the team for them to present. Electronically submitted protests must be on hard copy (printed by the team) 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 17 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 (no hard copy required). 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 23 February 2024.

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 (no hard copy required). 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 18 - 21 April 2024 and is anticipated to run from 12PM (1200) 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). 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 assure that all deadlines are known, understood, and met.

Fly-off Site

Host for the competition will be Textron Aviation. The fly-off is planned to be held at the Textron Aviation Employees' Flying Club in Wichita, KS. 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 information for non-US teams can be found [here](#).

Mission and Vehicle Design

Mission Task Matrix:

Urban Air Mobility

The objective for this year is to design, build, and test an airplane to demonstrate Urban Air Mobility (UAM) missions. Flight missions will include delivery of the airplane, medical transport, and urban taxi.

General:

- The airplane wingspan cannot exceed 5 feet.
- The airplane in the parking configuration, while on its landing gear in the upright orientation, must fit inside a parking spot 2 ½ feet wide.
- If the wingspan exceeds the parking spot width, then the airplane must be configured to fit without any components removed or separated from the airplane other than temporarily removing fasteners, locking pins or other mechanical retention devices, which must be replaced back on the airplane in their original location (no loose parts allowed).
- When transitioned back into the flight configuration, all retention methods must meet the requirements under Technical Inspection for positive retention of all components in flight.
- Payloads:
 - Mission 1 – Crew only.
 - Mission 2 – Crew, EMTs, Patient, gurney, and Medical Supply Cabinet.
 - Mission 3 – Crew and Passengers.
 - The Crew, EMTs, Patients, and Passengers will be provided at the competition. The Crew, EMTs and Passengers are shown in Figure 2 (3 ½ inch jumbo angel) and the Patient is shown in Figure 3 (5 ½ inch jumbo man). These are “wood peg dolls” and are available on Amazon and other sites for teams to obtain for trials and testing.

https://www.amazon.com/Unfinished-Angel-Dolls-Angle-Birch/dp/B01MQJZHVL/ref=sr_1_1_sspa?keywords=wooden%2Bpeg%2Bdolls&qid=1688655976&sr=8-1-spons&sp_csd=d2lkZ2V0TmFtZT1zcF9hdGY&th=1



Figure 2. Crew, EMTs, and Passengers.



Figure 3. Patient.

- The gurney must be at least the same width and length as the Patient at a minimum with a minimum height of 1.50 inches (minimum height of Patient above floor/insert).
- The Medical Supply Cabinet shall have a minimum width and length of 3.00 inches and a minimum height of 3.50 inches. The maximum weight is up to each team to decide and the weight can be varied for each mission attempt not to exceed the maximum weight declared in tech inspection.
- The airplane shall have a single plane, horizontal floor in the passenger compartment to carry the EMTs, Patient on gurney, Medical Supply Cabinet and Passengers. A separate insert on top of the horizontal floor may be used specific to each mission, if desired. The EMTs, gurney and passengers must be mounted upright and perpendicular to the passenger compartment floor.
- The Crew, EMTs, Patient on gurney, and Passengers must have a restraint system to secure them from moving during taxi, take-off, flight, and landing. The Patient must also be securely restrained to the gurney.
- The EMTs must be alongside of the Patient on the gurney as shown in Figure 4. The patient must be horizontal on the gurney parallel to the direction of flight. The Patient on the gurney can be placed on either side of the airplane / EMTs. The EMTs and Patient on gurney cannot touch each other or any part of the airplane other than the floor and restraint system or insert(s). The Medical Supply Cabinet can be forward or aft of the EMTs/Patient and must be secured from moving during taxi, take-off, flight, and landing.
- The Passengers must be placed in the passenger compartment as shown in Figure 5. The Passengers cannot touch each other or any part of the airplane other than the floor and restraints system or insert(s).
- The Crew (Pilot and Co-Pilot) shall sit on a horizontal plane and be placed side-by-side without touching each other or any part of the airplane other than the floor and restraint system. The crew horizontal plane does not have to be co-planar with the passenger compartment floor. There must be a solid bulkhead between the Crew and Passenger compartment as shown in Figures 4 and 5.

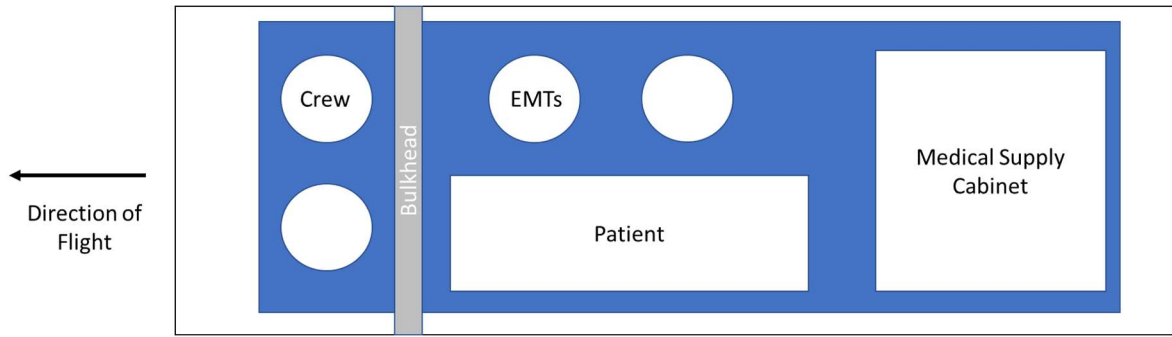


Figure 4. Medical Transport Mission Layout.

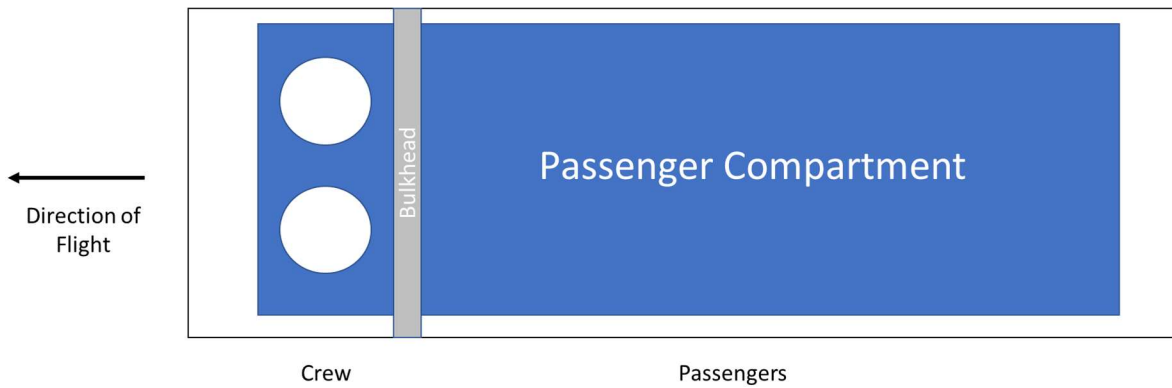


Figure 5. Urban Taxi Mission Layout.

- The Crew shall be in a cockpit such that their heads are above the fuselage forward of the cockpit as shown in Figure 6. It is incumbent on each team to assure this requirement can be verified in Tech Inspection.

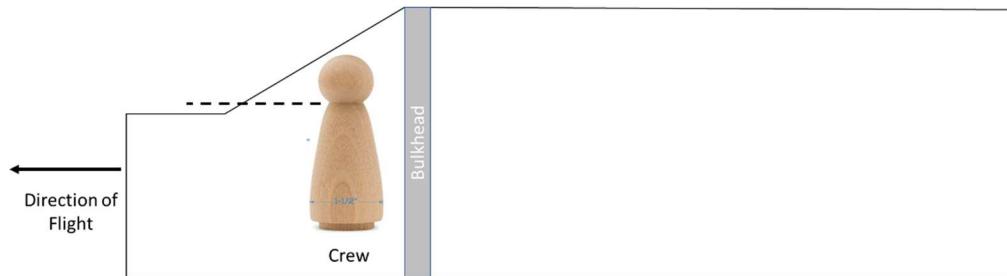


Figure 6. Crew Placement Above Forward Fuselage.

- The passenger compartment shall be accessed via a hinged hatch(es) on the side of the airplane. **The hatch opening cannot extend past the fuselage vertical centerline on top or bottom, including the hinge(s) for the hatch(es).** The hatch(es) are limited to a width of 6.00 inches. There is no limit to the number of hatches implemented. If more than one hatch is implemented, all hatches must be on the same side of the airplane.
- The Crew must be loaded via a separate hinged hatch(es) that is forward of the required bulkhead. This could include a hinged side hatch(es) or a hinged canopy on top.

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 condition with the maximum designed takeoff weight, to include the heaviest weight payload declared and heaviest battery 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 excluding payloads and optional passenger compartment insert(s), if used.
- 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 in the parking configuration with gurney, Medical Supply Cabinet, floor insert (if used) and propulsion battery pack(s) removed from the airplane.
- If you forget something you must leave the staging box and forfeit the flight attempt.
- Only the assembly crew member, pilot, and observer may go to and enter the staging box or Ground Mission area.
- **The assembly crew member is the only person who can touch the airplane while inside the staging box while preparing the airplane for flight.**
- Prior to starting assembly of the airplane, the propulsion battery pack will be inspected to verify it has been approved in Tech Inspection and the capacity recorded, and the Medical Supply Cabinet will be weighed to verify it does not exceed the maximum allowable weight and recorded. The teams will be provided with the Crew (all missions), EMTs and Patient (M2 only) and the number of Passengers requested not exceeding the maximum number of Passengers declared in Tech Inspection (M3 only).
- 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. One exception is to check balance using the wing tips with the aid of the observer or pilot. The airplane must be put into the flight configuration prior to installing any payload components or propulsion batteries.
- The airplane assembly and payload installation must be completed in less than 5 minutes.
- 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.
- The airplane must take-off within 20 feet of the start/finish line. All ground contact points of the airplane MUST be forward of the start/finish line.
- The initial upwind turn on the first lap of each mission will occur after passing the turn judge (signaled by raising a flag).
- The airplane must always remain in unaided visual control distance of the pilot. The Flight Line Judge may require turns to be made to remain in a safe visual control range at his discretion.
- 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

- The payload for Mission 1 is Crew only.
- The airplane will enter the staging box in the parking configuration with the propulsion battery(ies) removed.
- The ground crew will put the airplane in the flight configuration and install the battery(ies) and Crew 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: Medical Transport Flight

- The payload for Mission 2 is the Crew, EMTs, Patient on gurney, and Medical Supply Cabinet.
- The airplane will enter the staging box in the parking configuration with the propulsion battery(ies) removed. The staging box judge will weigh the Medical Supplies Cabinet and record the weight on the score sheet.
- The ground crew will put the airplane in the flight configuration and install the battery(ies), Crew, floor insert (if used), EMTs, Patient on gurney, and Medical Supply Cabinet within the 5-minute staging window.
- There will be a 5-minute window for this mission.
- Teams will be timed for 3 laps.
- The score will be a function of the Medical Supply Cabinet weight / time to fly 3 laps.
- 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:

$M2 = 1 + [N_{(\text{payload weight} / \text{time})} / \text{Max}_{(\text{payload weight} / \text{time})}]$, where “payload_weight” = Medical Supply Cabinet weight and $\text{Max}_{(\text{payload weight} / \text{time})}$ is the highest **payload weight / time** score of all teams.

Mission 3: Urban Taxi Flight

- The payload for Mission 3 is Crew and Passengers.
- The airplane will enter the staging box in the parking configuration with the propulsion battery(ies) removed. The staging box judge will record the battery capacity and number of passengers flown on the score sheet.
- The ground crew will put the airplane in the flight configuration and install the battery(ies), Crew, floor insert (if used) and Passengers within the 5-minute staging window.
- There will be a 5-minute window for this mission.
- The number of laps flown within the 5-minute window will be recorded.
- The score will be a function of the number of laps flown * number of passengers / rated battery capacity (Wh).
- 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:

$M3 = 2 + [N_{(\# \text{ laps} * \# \text{ passengers} / \text{battery capacity})} / \text{Max}_{(\# \text{ laps} * \# \text{ passengers} / \text{battery capacity})}]$, where $\text{Max}_{(\# \text{ laps} * \# \text{ passengers} / \text{battery capacity})}$ is the highest **(# laps * # passengers / battery capacity)** of all teams.

Ground Mission: Configuration Demonstration

- The Ground Mission is a timed mission to demonstrate efficiently changing mission configurations.
- The teams will enter the ground mission with the airplane in the parking configuration and no payloads or components installed. The propulsion battery is not part of the ground mission but flight controls will be verified at the completion of the mission.
- The assembly crew member and a pilot may participate in the Ground Mission; only the assembly crew member can touch the airplane and payloads.
- The mission will start with the airplane in the ground mission parking spot and Crew, EMTs, Patient, gurney, floor insert (if used) and Medical Supply Cabinet in the triage area next to the parking spot.
- Time will start when the ground mission judge says “GO”.

- The assembly crew member will remove the airplane from the parking spot, put the airplane in the flight configuration, load and secure for flight the Crew, EMTs, Patient on gurney, and Medical Supply Cabinet, and secure all hatches and doors then say “STOP” at which time the ground mission judge will stop the clock and verify doors and hatches are closed and secured.
- The pilot will verify all flight controls are working properly.
- The Passengers will then be staged in terminal area near the ground mission parking spot. The number of passengers must equal the maximum number of passengers declared in Tech Inspection.
- Time will re-start when the ground mission judge says “GO”.
- The assembly crew member will then remove the EMTs, Patient on gurney and Medical Supply Cabinet from the airplane (Crew may remain in place), change the floor insert (if used), load and secure for flight the Passengers, secure all hatches and doors then say “STOP”, at which time the ground mission judge will stop the clock and verify doors and hatches are closed and secured.
- The pilot will verify all flight controls are working properly.
- Time will re-start when the ground mission judge says “GO”.
- The assembly crew member will then remove the Crew and Passengers, put the airplane into the parking configuration and place it in the parking spot and says “STOP”, at which time the ground mission judge will stop the clock 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.
- No form of externally assisted take-off is allowed. All energy for take-off must come from the on-board propulsion battery pack(s).
- 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/resources/media/Airline_passengers_and_batteries.pdf
 - **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 vehicles will undergo a technical inspection by a designated contest tech inspector prior to being allowed to make any competition 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 in the parking configuration with no payload items or propulsion batteries installed.
- The Mission 2 Medical Supplies Cabinet will be at the maximum possible weight the team intends to fly (Note: teams will not be allowed to fly with a weight greater than this after completing tech inspection but can fly with less weight if they choose).
- Team members will declare the maximum number of Mission 3 Passengers
- 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. Verify all permanent fasteners are tight and have either safety wire, thread locker (Loctite™), or nuts/screws with a mechanical interference fit such as nylon inserts or patches or self-locking threads. 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 filled to its maximum payload and battery (combination) capacity.

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 crewmember 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 can not 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:

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

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 5 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: "2024DBF_[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 5 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 (40 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 (35 points):

- Decomposition of mission requirements into sub-system requirements.
- Preliminary design / sizing results; concept sketch, if available (does not have to be representative of the final design).
- Sensitivity Study of Design Parameters.

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.

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: "2024DBF_[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: "2024DBF_[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.

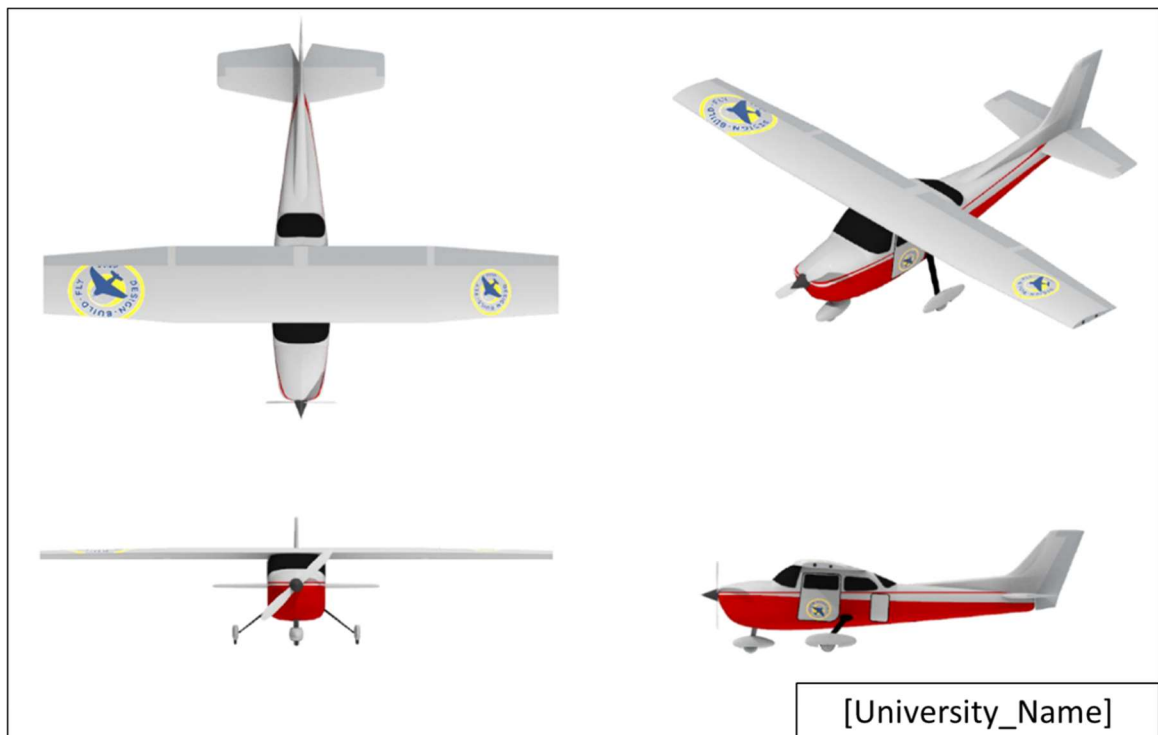


Figure 7. Configuration Drawing Format and Content.

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, Report Score will take precedence over Flight Score as a tie-breaker.

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 Design Report. A maximum of 100 points will be awarded for the team design report. The overall team score is a combination of the Design Report score and Total Mission 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 (<0.5 --> round down, >= 0.5 --> 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)

Total Score:

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

$$\text{Competition Score} = \text{Design Report Score} * \text{Total Mission Score} + P$$

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 Design Report Score. The Total Mission Score will be computed from the individual Flight Mission and Ground Mission Scores using the following formula:

$$\text{Total Mission Score} = M1 + M2 + M3 + GM$$