

## Overview

The Design Build Fly (DBF) competition brings students from all over the world together to design, build, and fly unmanned, electric-powered, radio-controlled aircraft that can best meet various mission profiles. DFB's first competition was held in 1997, and each year committees from AIAA pick a new theme for the competition. This is the 27th mission, and the theme is Electronic Warfare.

## Flight Missions

Design an aircraft to meet the requirements in the AIAA Design-Build-Fly 2023 competition. This competition includes three different flight missions and a ground mission. The course for the missions is shown in Figure 1. These missions include:

- Mission 1: No Payload**
- Complete 3 laps within 5 min
- Mission 2: Surveillance**
- Complete as many laps as possible in 10 min
  - Must carry an "Electronics Package"
  - Electronics package must compose 30% of aircraft's total weight
- Mission 3: Jamming**
- Complete 3 laps within 5 min
  - Attach "Jamming Antenna" on one wingtip
  - Antenna is ½" PVC pipe of maximum length
  - Antenna must be attached vertically
- Ground Mission**
- Aircraft must be supported by both wingtips
  - Aircraft will be loaded with test weight to maximum capacity
  - Must verify aircraft flight controls function while loaded

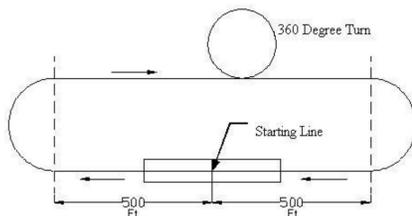


Figure 1. AIAA DBF Course

## Design Description

The design of the aircraft was optimized with the flight missions in mind. A sensitivity analysis was run to determine which aspects of the missions would affect the teams score the most. Based on the sensitivity analysis, the aircraft was designed to maximize the score in the competition. The design had the following aspects:

- High wing configuration
- Single propeller
- Carry-through spar
- 6-cell 4500 mAh LiPo battery
- Tri-pod landing gear
- Carbon fiber wings
- Fuselage folds in half
- 36" Carbon Fiber wings
- Full wing flaperons
- Detachable wings, rudder, tail, and landing gear



Figure 2. USU Competition Plane Assembled/Disassembled

## Performance Review

Throughout the testing process the initial design was refined to accomplish the missions. Initial analysis resulted in exceptional stability and maneuverability and did not need rework. The design of the aircraft was also capable of being disassembled to fit in a box with dimensions of 37x14x11 in as shown in Figure 2. The empty weight of the aircraft was 8.5 lbs.

In testing it was found the carry-through spar was not strong enough when the aircraft was fully-loaded. A new carry-through spar was designed to handle the g-force of the plane when fully loaded. The 60 ft take-off also proved difficult when the aircraft was fully loaded. A 3-bladed propeller was used to increase thrust in the second mission to ensure a 60 ft take-off was achieved. Testing proved the aircraft could complete the course with an antenna length of 30 in. Flight testing proved the aircraft could carry 3.5 lbs which was a 29% mass fraction. Further ground testing proved the final aircraft could carry 3.7 lbs which is within the 30% mass fraction criteria.

## Aircraft Constraints

### Aircraft Constraints

- All components must fit in a box of with a total of 62 linear inches
- A maximum weight of 50.00 pounds including the shipping box.
- Must have Max takeoff distance of 60 ft
- Must have 2 sets of wings that are interchangeable numbered L1, L2, R1, and R2

### Battery Constraints

- Maximum of one (1) 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
- Total stored energy must not exceed 100 Whr

### Payload Constraints

- Electronic Package must meet or exceed 3" x 3" x 6"
- Must meet or exceed 30% gross vehicle weight
- Must be carried internally to the aircraft and must not extend outside the aircraft
- Teams may bring up to 3 antennas
- Antenna material must be unmodified schedule 40 PVC
- Antenna must not use internal stiffeners
- Antenna must be attached to wingtip with two (2) fasteners with an adapter
- Antenna must not project below the lower surface of the wing

### Ground Test Fixture

- Test fixture must attach to the wing using the same interface as antenna adapter
- Test fixture must support aircraft without aircraft touching ground

## Conclusion

In many instances the initial design met the mission criteria. In testing, certain aspects of the aircraft were refined to better accomplish the missions. The final aircraft was optimized for the missions through the process of testing and re-design. The final aircraft meets all requirements to complete the missions of DBF's 2023 competition.

## Acknowledgements

Our team would like to thank the following:

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- Ashton Gilbert – Pilot
- USU's Design Build Fly Club
- Professor Jackson Graham for his mentorship on the project