

SPEEDFEST VII ALPHA CLASS
STATEMENT OF WORK
FOR A
TURBINE-POWERED ADVANCED UAS TARGET DRONE

- 1. SUMMARY.** There is a need for an advanced turbine-powered target drone to train US defense personnel in the identification, tracking, and elimination of small, low-cost, fast moving UAS threats. Presently, such a drone does not exist, but is a critical need in order to stay ahead of threats as they develop. The aircraft developed under this program must be low-cost, easy to operate, reliable, have a very small footprint of ground operation, and have a low radar cross section (RCS). Contractors will develop and demonstrate prototype aircraft subject to the objectives of this document, and the winning design will be chosen by a qualified team of judges selected from the aerospace industry, government, and academia.

- 2. REFERENCES.** AMA Turbine Waiver Application 510-d, AMA Safety Regulations for Model Aircraft Powered by Gas Turbines 510-a, Official AMA National Model Aircraft Safety Code 105.

- 3. SCOPE.** This document includes all required objectives, Key Performance Parameters (KPP), Key System Attributes (KSA), and Measures of Performance (MOP), for the contractor to provide essential engineering, research, development, test and evaluation.

- 4. DESIGN REQUIREMENTS AND CONSTRAINTS.**

Aircraft not meeting the following list of requirements and constraints will not be considered for evaluation:

- 4.1. The aircraft must be designed around, and include an unmodified Kingtech 45 Turbine engine. (Only factory-directed changes to the engine or control software are allowed.)
- 4.2. Design should be FOD resistant for engine longevity.
- 4.3. Aircraft and all ground support equipment must be packed within a box no larger than 48"x84"x27" outer dimensions.
- 4.4. Aircraft must have provisions for a forward facing camera
- 4.5. Aircraft must have an avionics bay large enough for flight control/receiver system as well as a Pixhawk autopilot. (Autopilot not required)

- 4.6. Design must satisfy *all* AMA requirements detailed in 510-a “Safety Regulations for Model Aircraft Powered by Gas Turbines” including 7.5 lb weight requirements.
- 4.7. Aircraft must be stable with good handling qualities, and minimal pitch moment change with thrust over entire envelope
- 4.8. Aircraft must have safety telemetry to monitor at least flight system voltage and airspeed. Warnings must include at least airspeed low, and voltage low.
- 4.9. Control surfaces shall be linked to servos with 4-40 rods, Robart Super Ball horns. Clevis connectors must lock or be secured with tubing. Horns shall have the ball directly over the hinge line, and plates bolted on each side of the control surfaces. Control surface under the horn plates must be solid. Control slop and flexibility must be minimal.
- 4.10. All servos must be mounted within a servo mount, and mechanically fastened.
- 4.11. All servos must be metal gear type.
- 4.12. Wiring, and any pneumatic harnesses must be labelled.
- 4.13. All servo and other electrical connections must have mechanical locks.
- 4.14. Turbine and any electrical retract / brake systems must be powered independently from receiver.
- 4.15. Radio systems must be Futaba 2.4 GHz Spread Spectrum. Range / fail safe testing will also be performed at the event.

5. DESIGN OBJECTIVES.

Objectives 5.1 – 5.9 involve Key Performance Parameters used for scoring.

- 5.1. Ease of operation: Threshold: Unpack all systems from box to flight ready in 20 min. Objective: Unpack to flight ready in 10 minutes. Fuel must not be in the airplane to begin. Any pneumatic systems may not be charged. “Flight Ready” means ready to takeoff. Time does *not* include any preflight checklists prior to takeoff.
- 5.2. Ground Ops Radius: Threshold 100 ft. Objective: Best of Competitors. Ground radius includes any launch and recovery systems, and any ground roll of aircraft. Pilot location not included in radius.
- 5.3. GTOW: Threshold: 9 lb, Objective: 7.5 lb.
- 5.4. Endurance. Threshold: 3 min @ WOT. Objective: 5 min @ WOT
- 5.5. Maximum level flight airspeed. Threshold: 120kts. Objective: Highest of Competitors (up to 173kts)

- 5.6. Evasive Maneuvering. Threshold: Demonstrate a horizontal figure-8 with turns away from the spectators, a Cuban 8, and an Immelmann turn. Objective: "Best of Show" Integrate threshold maneuvers into a flight routine to music and/or narration. Add aggressive maneuvers that show the capabilities of the airplane. *At no time may a maneuver direct the aircraft towards the safety line.* Best of Show score judged by spectators as well as judges. Spectators may use all aspects of contractor's display (static and flight maneuvers) to vote.
- 5.7. Unit Cost Bid. Cost for sale of each airframe using the cost analysis guidelines of section 14. Unit costs will not be revealed until event day. Detail must be provided sufficient for the Technical Reviewers to judge if the price is realistic. Threshold: \$10,000 / plane. Objective: Lowest certified bidder
- 5.8. RCS: Contractors must use open source information on low RCS design and justify to judges the merits of the design. Minimal frontal RCS for monostatic radar is a priority. Objective: Best score of judges.
- 5.9. Reliability: Threshold: Perform two consecutive flights with a single airplane within a 10-minute flight window. Objective: Most consecutive flights with a single airframe for the event. Each aircraft must have clearly visible and distinctive numbers.

6. PROGRAM MEETINGS, REVIEWS, AND EVENTS.

- 6.1. Program Management Review (PMR) Contractors shall present a PMR on or prior to **1 February, 2017**. The PMR shall consist of briefing slides through conceptual design of the aircraft. Slides should consist of sections for: Program management including schedule and budget, performance, aerodynamics and stability and control, propulsion, structures.
- 6.2. Critical Design Review (CDR) Contractors shall present a CDR on or prior to **22 February 2017**. The CDR shall consist of briefing slides through preliminary and detailed design of the aircraft. Slides should consist of sections for: Program management including schedule and budget, performance, aerodynamics and stability and control, propulsion, structures, test and evaluation plan.
- 6.3. Speedfest Competition Safety inspection. **Friday, 28 April 2017**. Contractors shall present their aircraft to the Speedfest judges for safety and requirements inspection.
- 6.4. Speedfest static and flight demonstrations. Contractors will present deliverables outlined in this document for judging.
- 6.5. Contractors must present proof of flight that the aircraft design has flown *prior to Friday, 28 April 2017*, in order to be allowed to compete in the event. First flight may *not* be conducted at the Speedfest site. If the deadline is not met, the aircraft will not be allowed to fly at the event (including Friday), and the team's

score will not count in the standings. Proof of flight must be a video showing a single flight consisting of: takeoff, all three 5.6 Threshold maneuvers, and a safe landing. Pilot and advisor must certify authenticity. Pilots must also disclose any handling qualities concerns to the judges.

7. TEST FACILITIES AND EQUIPMENT.

- 7.1. The Speedfest event is an AMA contest, and as such will be conducted under all AMA safety guidelines at the AMA-sanctioned UAFS airfield.
- 7.2. Speedfest will provide the test range and judges for the event.
- 7.3. Contractors will be required to bring their aircraft and all associated equipment including fuel.
- 7.4. Contractors will be required to provide an exhibit tent for static display and presentations to the judges and public. Installation and rental of the exhibit tent will be coordinated with the Speedfest contacts.
- 7.5. Contractors will be required to provide a CO₂ fire extinguisher as part of the required airplane ground equipment.

8. DELIVERABLES.

- 8.1. Recommended minimum of two aircraft; one for flight demonstrations and one for static display and judging. One of the aircraft shall be in university-themed graphics and colors. The other may be contractor's discretion. Each airplane must be painted with clearly legible number.
- 8.2. A 2 minute marketing video
- 8.3. A static display. Examples of marketing information in the display include: a marketing brochure outlining the features and capabilities of the aircraft. or A quad-chart poster (36" tall x 48" wide) for static display, legible from 6 ft (minimum 32 pt Calibri font). Other items that display some aspect of the aircraft.
- 8.4. A detailed cost analysis per guidelines in this document, with a unit cost bid to be revealed at the Speedfest event.
- 8.5. A detailed RCS design justification.

9. **INTEGRATED MASTER SCHEDULE (IMS).** Contractors shall develop and maintain a detailed Integrated Master Schedule incorporating all tasks and milestones necessary for completion of the project. IMS shall be continuously updated, and presented at all design reviews.

10. TECHNICAL REVIEWS. Technical reviews of the contractors work will be provided at the Speedfest event. Technical review team will consist of individuals from the aerospace industry, government, academia. Handling qualities will be scored by pilots. Reviews will be documented on scoring sheets that will be used to select the winning contractor.

11. PERIOD OF PERFORMANCE (PoP). Total PoP for this SOW is 15 weeks.

12. POINTS OF CONTACT: All questions should be sent via email to SpeedfestAERO@gmail.com

13. SCORING.

The scoring system below will be used to select the winning contractor.

Objective scoring:

Objective #	Objective	KPP Score	
		Threshold	Objective
5.1	Ease of Operation	2	4
5.2	Ground Ops Radius	4	8
5.3	GTOW	2	4
5.4	Endurance	2	4
5.5	Max Speed	2	4
5.6	Evasive Maneuver	4	8
5.7	Unit Cost Bid	4	8
5.8	RCS	0	6
5.9	Reliability	2	4
Subtotal Possible		22	50

Subjective Scoring:

The following scores will be judged by the Technical Review teams outlined in this document. Scores will be averaged on the following scale:

Aircraft Design	
Fit and finish	0-10
Handling Qualities	0-10
Design for intended use	0-10

Cost bid certification	*
Subtotal Possible	30
Display	
Static display	0-15
Video (scored by electronic vote)	0 OR 5
Subtotal Possible	20

* Technical Review team will certify that the cost bid is reasonable based on detailed and convincing evidence provided by the contractors. Majority vote in the affirmative will certify. If the majority votes in the negative, the objective 5.7 score will be scored 0.

14. COST ANALYSIS

Cost Analysis must be based on the projection that the winning contractor goes on to create new production tooling as well as 100 units. Final cost analysis must show unit costs for sale of individual airframes including all of the following factors:

Labor and materials for all tooling and 100 airplane systems (including any launch and recovery gear. One launch and recovery system for every 4 airplanes.). Assume a fully loaded labor rate of \$40/hr. All tooling, aircraft, and ground support materials and equipment, radio gear, etc. needed to operate each aircraft with the exception of fuel, must be included in the bid. Contractors should track labor during production of the prototypes, and be able to justify projected labor man-hours in the following categories as appropriate:

Production Tooling

Fuselage

Empennage

Wing

Finish, Paint and Graphics

Flight control systems (servos, linkages, telemetry, wiring harness, electrical systems)

Propulsion integration

Landing gear system

Launching system

Recovery system

Contractors may apply projections of cost reductions for 100 aircraft using quantity discount information, as well as learning curves for labor hours. Use of machining such as a CNC shall be included at \$95/hr

15. SPEEDFEST EVENT DEMONSTRATION REQUIREMENTS

When a team is granted their flight demonstration window, they must announce to the judges table, which objective(s) they will be demonstrating. They may demonstrate more than one objective on a flight.

The following is a list of the acceptable methods for demonstrating objectives:

	OBJECTIVE	LOCATION	METHOD
5.1	Ease of Operation	Event Day	Demonstration score
5.2 ¹	Ground Ops Radius	Event Day	Demonstration score
5.3	GTOW	Event Day	Demonstration score
5.4	Endurance	Event Day or Prior	Static Test at WOT. Adviser may certify for judges.
5.5 ²	Max Speed	On or prior to Fri 28 April	Demonstration score. See ² below
5.6	Evasive Maneuver	Event Day	Demonstration. Judges and spectators score
5.7	Unit Cost Bid	Event Day	Judges score
5.8	RCS	Event Day	Judges score
5.9	Reliability	Event Day	Demonstration score
	Fit and Finish	Event Day	Judges and pilots score
note ³	Handling Qualities	Event Day	Pilots score**
	Design for Intended Use	Event Day	Judges score
	Static Display	Event Day	Judges score
	Video	Prior	Public scores. See website for rules.

1 The intent of the objective is to determine the true ground operating distance needed for the airplane. The method used will be to measure the farthest distance that the airplane uses the ground or any object touching the ground, for the purpose of takeoff or landing. The measurement object will be the airplane, and the locations on the plane used for measurement will be the points that make the measurement the largest.

- 2 For Objective 5.5, speeds will be calculated by time required to fly over a 900 ft course, both directions (to account for wind), and the two speeds averaged. In other words: $(V_{\text{upwind}} + V_{\text{downwind}})/2$
- 2 Objective 5.5 must be completed before Saturday. Speed trials will not be allowed after Friday, 28 April. If not done at Speedfest site, advisor must certify it was done in accordance with above.
- 3 Pilots will provide a score for their teams' plane based on a C-H scale but with 10 being the high score, and 1 being low score.