

# **SPEEDFEST VIII ALPHA CLASS**

## **STATEMENT OF WORK**

### **FOR A**

#### **HIGH-SPEED, LOW-OBSERVABLE ATTACK/SENSOR DEPLOYMENT UAV**

- 1. SUMMARY.** Contractors are requested to demonstrate their ability to quickly design, develop and test, a high-speed attack/sensor deployment UAV. The primary mission objective is the ability to separately deliver two payloads accurately in minimum time while evading detection by radar. 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.** Official AMA National Model Aircraft Safety Code 105. If Applicable: AMA Turbine Waiver Application 510-d, AMA Safety Regulations for Model Aircraft Powered by Gas Turbines 510-a.
  
- 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. Any commercially available propulsion system is allowed, including turbojets. Only factory-directed changes to the engine or control software are allowed.
  - 4.2. Design should be FOD resistant for engine longevity.
  - 4.3. If turbojets are used, design must satisfy *all* additional AMA requirements detailed in 510-a "Safety Regulations for Model Aircraft Powered by Gas Turbines" including 7.5 lb weight requirements.
  - 4.4. Aircraft must be stable with good handling qualities. This must be demonstrated and certified by the contractor pilot before flying at the Speedfest event.
  - 4.5. Aircraft must have safety telemetry to monitor at least flight system voltage and airspeed. Warnings must include at least airspeed low, and voltage low.
  - 4.6. 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.

- 4.7. All servos must be mounted within a servo mount, and mechanically fastened.
- 4.8. All servos must be metal gear type.
- 4.9. Wiring, and any pneumatic harnesses must be labelled.
- 4.10. All servo and other electrical connections must have mechanical locks.
- 4.11. Flight control must be manual and under full control of the pilot only at all times, using Futaba 2.4 GHz Spread Spectrum transmitter and receiver systems. Range / fail safe testing will also be performed at the event.
- 4.12. Futaba receiver must be powered from a battery independently from all other systems and may not use a voltage regulator. The propulsion system, and any other system may not be powered from the receiver power source.

**5. DESIGN OBJECTIVES.** Objectives 5.1 – 5.5 involve Key Performance Parameters used for scoring.

- 5.1. EDR Mission: The Evade, Deploy, Recover mission is made up of 4 parts that all happen during a single flight. Scoring for each part is only granted on a per-flight basis so scores cannot be combined from different flights. The best mission score attained by a team during the competition will be the final score recorded for standings.

Refer to the attached figure at the end of the document for graphical details of the mission. Time begins upon crossing of south flag Northbound. Flags are separated by 1000 ft. Aircraft must fly 2 flags, deploy, fly 2 flags, deploy, fly 2 flags then land. Time stops at the crossing of the last flag.

- 5.1.1. Evade: The aircraft must be designed to evade Doppler radar. For the purposes of this exercise, Ka band Doppler radar will be used at approximately 34.7 GHz. The Doppler radar gun will be sighted continuously at the airplane as soon as the aircraft has begun the turn for the deployment run, until the team signals payload drop. Points are awarded based on the detect zone reached before the aircraft speed is detected by the radar for each deploy run. Zones are identified by passage of pylon flag, and by callout of payload release. Callout must be loud so judges can hear it. Whistles or horns may be used. Zone C: 0 pts, Zone B: 4 pts, Zone A: 8pts.
- 5.1.2. Deploy: Aircraft must carry two payloads and deploy them accurately into the target area, at separate times during a single mission. Each payload must meet the specifications detailed in section 16. Scores for each zone are: 8 points for each payload in the 50ftx50ft bullseye zone, 4 points for the 100ftx100ft zone outside of the bullseye, and 1 point for successfully deploying outside that zone.

- 5.1.3. Recover: Points are awarded for operating within a small footprint. : 4 points for using <100 ft. of runway for T/O and landing, and 8 points for <50 ft. Grass or matt runways are available.
- 5.1.4. Normalized Mission Speed: For each round, points will be awarded to the team with the highest normalized mission score. Normalized mission score is the sum of EDR score divided by the time for that mission in minutes.
- 5.2. Maximum level flight airspeed. Threshold: 120kts. Objective: Highest of Competitors (up to 173kts)
- 5.3. Best of Show: Best of Show winner judged by spectators as well as judges. Spectators may use all aspects of contractor's display (static and flight maneuvers) to vote.
- 5.4. Unit Cost Bid. Cost for sale of each airframe using the cost analysis guidelines of section 14. Detail must be provided sufficient for the Technical Reviewers to judge if the price is realistic. Threshold: \$10,000 / plane. Objective: \$6,000 / plane
- 5.5. Range: Threshold: 10km (represented by 13 figure-8 laps). Objective 15km (represented by 20 figure-8 laps)

## 6. PROGRAM MEETINGS, REVIEWS, AND EVENTS.

- 6.1. Program Management Review (PMR) Contractors shall present a PMR on or prior to **31 January, 2018**. 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. Slides from this presentation must be emailed to the Speedfest email address no later than COB this date.
- 6.2. Critical Design Review (CDR) Contractors shall present a CDR on or prior to **21 February 2018**. 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. Slides from this presentation must be emailed to the Speedfest email address no later than COB this date.
- 6.3. Speedfest Competition Safety inspection. **Friday, 27 April 2018**. Contractors shall present their aircraft to the Speedfest judges for safety and requirements inspection. 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, 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 and a safe landing. Pilot and advisor must certify authenticity. Pilots must also disclose any handling qualities concerns.

6.4. Speedfest static and flight demonstrations. Contractors will present deliverables outlined in this document for judging.

## **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, display tent, 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 a CO<sub>2</sub> fire extinguisher as part of the required airplane ground equipment. The extinguisher must be with the flight team at all times while operating the engine.

## **8. DELIVERABLES.**

8.1. Recommended minimum of two aircraft; one for flight demonstrations and one for static display and judging.

8.2. A 2 minute marketing video per guidelines and deadline on Speedfest website.

8.3. A static display. Examples of marketing information in the display include but are not limited to: a marketing brochure outlining the features and capabilities of the aircraft, a quad-chart poster (36" tall x 48" wide) for static display, legible from 6 ft. Other items that display some aspect of the aircraft.

8.4. A detailed cost analysis per guidelines in this document.

**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. POINTS OF CONTACT:** All questions should be sent via email to [SpeedfestAERO@gmail.com](mailto:SpeedfestAERO@gmail.com)

## 12. SCORING.

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

### Objective scoring:

Objective #	Objective	KPP Score	
		Threshold	Objective
5.1	EDR Mission		
5.1.1	Evade		16
5.1.2	Deploy		16
5.1.3	Recover		8
5.1.4	Norm. M. Speed		8
5.2 <sup>1,2</sup>	Max Speed	3	5
5.3	Best of Show		4
5.4	Unit Cost Bid	5	8
5.5 <sup>3</sup>	Range	2	5
	<b>Subtotal Possible</b>	<b>10</b>	<b>70</b>

Per Mission Scoring

### 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:

<b>Aircraft Design</b>	
Fit and finish	0-5
Handling Qualities <sup>4</sup>	0-5
Design for intended use	0-5
Cost bid certification	*
<b>Subtotal Possible</b>	<b>15</b>
<b>Marketing</b>	
Static display / Presentation	0-10
Video	0 OR 5
<b>Subtotal Possible</b>	<b>15</b>

NOTE: See numbered notes in section 14.

\* 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 5.4 score will be scored 0.

### **13. 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. Assume labor to build the aircraft would be drawn from the same individuals who built the prototypes. 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/recovery and ground station 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, electrical systems)
- Propulsion integration
- Landing gear system
- Payload system
- Launching/Recovery/Ground system

Contractors may apply projections of cost reductions for 100 aircraft using quantity discount information, as well as logarithmic learning curves for labor hours. Learning curve projected man hours at the 100<sup>th</sup> unit may not be projected to drop below 50% of the lowest number of man hours documented for the final prototype actually built by the contractor. Use of machining such as a CNC shall be included at \$95/hr

### **14. SPEEDFEST EVENT DEMONSTRATION REQUIREMENTS**

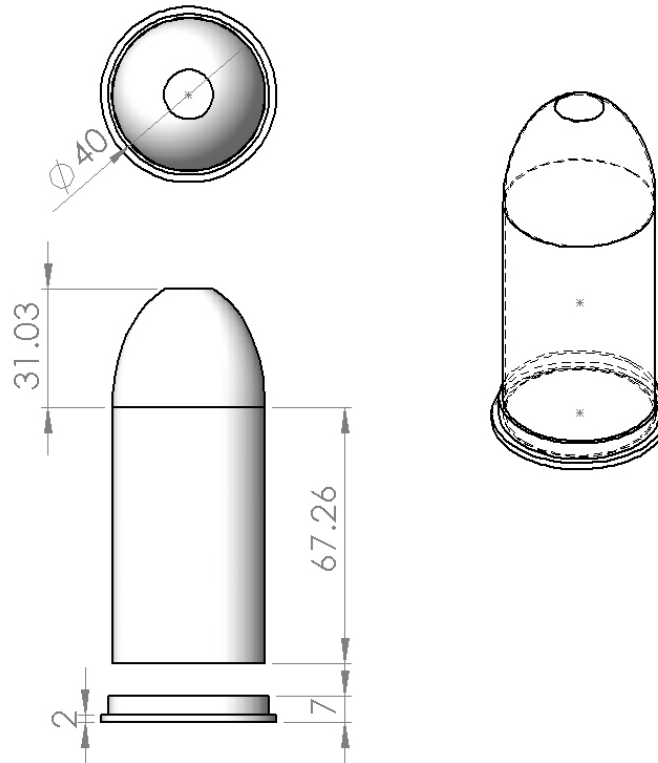
When a team is granted their flight demonstration window, they must announce to the judges table, which objective(s) they will be demonstrating. They may demonstrate more than one objective on a flight.

- 1 For Objective 5.2, speeds will be calculated by time required to fly over a 1000 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 5.2 must be completed before Saturday of Speedfest. Speed trials will not be allowed after Friday, 27 April. If not done at Speedfest site, advisor must certify it was done in accordance with above.

- 3 Objective 5.5 range may be completed before Speedfest if the team wishes, and the range witnessed and certified by the advisor. Teams must complete the required laps with the same aircraft configuration, and no more fuel than will be used for performing missions at Speedfest.
- 4 Pilots will provide a score for their teams' plane based on a C-H scale but with 5 being the high score, and 0 being low score.

## 15. PAYLOAD SPECIFICATIONS

The payloads consist of a main body and an end cap, and may be seen below. All dimensions are in mm, and an .STL file will be provided on the website for teams to be able to 3D print their payloads.



Rules and specifications for the payloads are as follows:

- The payloads must be made from PLA and must have a mark unique to the contractor for identification. Bright colors are preferred to aid in visibility. The outside of the payloads may be painted, but the inside should remain bare so the judges may confirm the material and volume.
- The payload structure may not be modified in any way including drilling. If anything is to be externally attached to a payload, it must be removable so the judges can verify weight and dimensional compliance.
- Each contractor is responsible for their own payloads, and it is recommended to bring at least 8. contractors will bring their empty payload containers to the judges during tech-in, at which point they will be *completely* filled with dry sand of a type similar to Quikrete General Purpose sand to a weight of approximately 185g. The contractor will then bond the end caps on with a CA adhesive. No other fill material may be used.
- Payloads will not be recovered immediately, but after each Alpha round is over. For a payload score to count, the payload and all associated parts must be recovered within 10 min from the time when judges clear teams to locate them.



