

**SPEEDFEST C CLASS
STATEMENT OF WORK
FOR A
DEMONSTRATION OF HIGH-SPEED AUTONOMOUS AIRCRAFT RESCUE AND
FIREFIGHTING (AARFF) VEHICLE**

1. **SUMMARY:** Contractors are requested to demonstrate their ability to design, develop, and test, a high-speed Autonomous Aircraft Rescue and Firefighting (AARFF) vehicle, which can navigate through a prescribed ground course autonomously, extinguish a pot fire, and return to the “fire station” while avoiding obstacles.

Contractors will develop AARFF vehicle subject to objectives of this document, and the winning design will be chosen by a qualified team of judges selected from industry and/or academia.

2. **SCOPE:** This document includes all required design requirements and constraints for the contractor to provide essential engineering, research, development, test and evaluation.

3. **GROUND MISSION:**

- Each heat race shall consist of all functioning teams competing simultaneously in head-to-head racing.
- The course shall be marked by pairs of cones. Each vehicle must pass between the pairs in the given order. Failure to do so will result in a Did Not Finish (DNF) score for that heat.
- The ground mission must be achieved completely autonomously. No navigation or command signals of any type may be sent to the vehicle once it begins moving other than the emergency kill command.
- Teams will be allowed to preview the course for GPS coordinates and visual cues, but cones may be moved by up to two (2) meters from the GPS coordinates provided by the officials.
- Obstacles may be present on the course and the locations may change every race and coordinates will not be provided.
- Each vehicle will be required to extinguish a pot fire (12 in diameter circular pot) with a fire extinguishing system carried onboard the AARFF vehicle at separate times in each heat at designated locations.
- Teams will be provided between three (3) to eight (8) opportunities to complete the course (“Heat Races”).
- The top three scores for each team will be summed along with the points for the best heat time and subjective scoring to give the final score. Please refer to the scoring section for details.
- Each heat will grid the teams according to the previous heat times with pole position going to the fastest time.
- Course completion time will be the length of time from the vehicle crossing the simulated fire station (starting line) to crossing the finish line.

4. RACE SEQUENCE

- Only teams that are called to the flight line may pass the spectator line and enter the course. They must wear the appropriate safety gear.
- **Charlie Class:** Each team must report to the starting line promptly after the final heat of the previous class. Failure to report promptly and start on time will result in a DNF. Failure to leave the course in the window will result in forfeiting the team's time slot in the next round. Continued violation will result in losing best score.

5. DESIGN REQUIREMENTS AND CONSTRAINTS. The AARFF vehicle not meeting the following list of requirements and constraints will not be considered for evaluation:

A. General and Safety Requirements

- The AARFF vehicle must have both manual and automatic emergency kill options to disable it in case of any danger to itself or the audience.
- The AARFF vehicle must automatically be disabled in case of flipping over.
- The autonomous AARFF vehicle must have telemetry capability and remote controller for the kill switch and manual operation.

B. Course

- The course will consist of a combination of grass, sand, thin mud, and runway mat.
- The course will include the fire pots and a simulated fire station (starting point).
- The students will have access to the course prior to the competition for final testing.

C. Team Name and Color

- Each team will choose their own team name and color. In case of conflicting choice the team first picked the name and color will be allowed to keep the name and color.
- Each team will mark their AARFF vehicle body with their team name. Team names should be creative, but professional. Lettering shall be clearly legible and sized at least 0.5 inches tall. Abbreviations may be used.
- Each vehicle shall be attractively presented with the dominant color being the color assigned to the team.

D. Mechanical Requirements

- Electric powered system
- Wheelbase: Up to 24 inches (Approximately 1/25 scale of an Oshkosh Striker 8x8)
- Payload: Must carry a fire extinguishing system
- Paint and body design must be attractive as per the specified color

E. Navigation requirement

- The AARFF vehicle is required to navigate both autonomously and remotely by an operator on the given course.
- The AARFF vehicle must navigate through pairs of cones by detecting the cones. The approximate GPS coordinates of the cones will be provided.
- The AARFF vehicle must have additional navigation systems to navigate through the GPS denied areas, in case of loss of GPS signal, and/or to identify obstacles and cones.
- The teams can choose their own controllers for navigation.

F. Obstacle avoidance requirements:

- The AARFF vehicle must be equipped with autonomous obstacle avoiding sensing technology. GPS coordinates for the obstacles **will not be provided**.
- In case the AARFF vehicle is unable to avoid obstacle, it must stop at least a distance of 3 meters away from the obstacle.
- The teams are allowed to choose their sensors and additional controllers of choice.

G. Mission requirements:

- The AARFF vehicle must detect the pot fire and extinguish it and return to the “fire station.”
- Deploy an extinguishing system for the Jet A or nitromethane fuel fire.
- The AARFF vehicle must acquire the fire using any sensing technology. Approximate GPS coordinate for the fire zones will be provided. Each team will have their own fire zone.
- A 12 inch diameter (round) pots with 2 inches depth will be used for creating fire.
- Teams are free to choose the actuation systems and all associated electro-mechanical control mechanisms to deploy the fire extinguisher.
- The payloads consist of any fire extinguishing system.

6. SCORING

- **Heat Races:**
 - The first place team will be awarded 150 points. Each position thereafter will be reduced by 20 points. i.e. 2nd place will be 130 points, 3rd place will be 110 points, etc. The points will not go lower than zero and a DNF is worth zero points.
- **Mission:**
 - Each team that extinguishes the pot fire will be awarded 50 bonus points.
 - If the fire is not extinguished, teams released the fire extinguishing a system within a radius of 2 meters of the fire pot will be awarded 25 bonus points.
 - Fire extinguishing system deployment outside the 2 meter radius and within the fire zone will be given 10 bonus point.
 - The teams unable to deploy the extinguishing system will be given negative 25 points.

- **Time Bonus:** The team with the fastest single heat time with successful deployment of extinguishing system will be awarded an additional 100 points.
- **In the event of a tie,** the best three heat times will be added up with the winner having the lowest total value. If a tie remains, further heat times will be added until the tie is broken.
- **Subjective Scoring:** Teams will be required to defend their design for function and appearance verbally before a team of judges. A summary of the judges' scores will determine placement. The first place team will be awarded 50 points. Each position thereafter will be reduced by 10 points. i.e. 2nd place will be 40 points, 3rd place will be 30 points, etc. All teams finishing lower than an equivalent of zero points will be given zero points.
- **Promotional Video:** Each team is required to create a short promotional video (see below). Failure to create said video by 04/20/2020 will result in the team losing their best heat score.

Useful links:

<http://www.oshkoshairport.com/arfftrucks/newstriker>

<http://www.oshkoshairport.com/new-snozzle>

<https://www.dfwairport.com/firetraining/>

<https://www.youtube.com/watch?v=IITmlntCTyl>

FAR 139

https://www.faa.gov/airports/airport_safety/aircraft_rescue_fire_fighting/

[https://www.ecfr.gov/cgi-bin/text-](https://www.ecfr.gov/cgi-bin/text-idx?SID=1d9395ff600fb97d02fd3c17147cf748&mc=true&node=se14.3.139_1317&rgn=div8)

[idx?SID=1d9395ff600fb97d02fd3c17147cf748&mc=true&node=se14.3.139_1317&rgn=div8](https://www.ecfr.gov/cgi-bin/text-idx?SID=1d9395ff600fb97d02fd3c17147cf748&mc=true&node=se14.3.139_1317&rgn=div8)

[https://www.ecfr.gov/cgi-bin/text-](https://www.ecfr.gov/cgi-bin/text-idx?SID=1d9395ff600fb97d02fd3c17147cf748&mc=true&node=se14.3.139_1319&rgn=div8)

[idx?SID=1d9395ff600fb97d02fd3c17147cf748&mc=true&node=se14.3.139_1319&rgn=div8](https://www.ecfr.gov/cgi-bin/text-idx?SID=1d9395ff600fb97d02fd3c17147cf748&mc=true&node=se14.3.139_1319&rgn=div8)