



## 6<sup>th</sup> RoboBoat Competition - Final Rules

Sponsored by the AUVSI Foundation and the US Office of Naval Research

**8-14 July 2013**  
**Founders Inn and Spa, Virginia Beach, VA**

**Note: Corrections, addendums and clarifications may be posted online on the [RoboBoat forum](#).  
Please follow the forum activities until the start of the competition.**

The goal of this competition is to provide an opportunity for students to experience the challenges of and develop skills in system engineering by accomplishing realistic missions with autonomous vehicles in the maritime environment and to foster ties between young engineers and the organizations developing Autonomous Surface Vehicle (ASV) technologies.

### SCHEDULE\*:

Event		Due Date
Intent to Compete Form and Payment Due	Friday	1 March 2013
Hotel (Founder's Inn) reservation deadline	Wednesday	15 May 2013
T-shirt sizes	Saturday	1 July 2013
Website, Team Video, Journal Paper & Resumes	Friday	17 July 2013
Team Check-in & Orientation	Tuesday	9 July 2013 1000 hrs
Safety Inspections and In-water Practice Time	Tuesday	9 July 2013 1200 hrs
In-water Practice Time	Wednesday	10 July 2013 1200 hrs
In-water Practice Time	Thursday	11 July 2013 0800 hrs
Static Judging and In-water Practice Time	Friday	12 July 2013 0800 hrs
Qualifying Runs	Saturday	13 July 2013 0800 hrs
Qualifying Runs/Last chance and practice time	Sunday	14 July 2013 0800 hrs
Finals	Sunday	14 July 2013 1300 hrs
Awards Party (evening)	Sunday	14 July 2013 1900hrs

\* The event will be held rain or shine. Exact times may vary due to schedule delays or unsafe/bad weather.

### POINTS OF CONTACT:

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# 1 General Information

## 1.1 Background:

The goal of this competition is to provide an opportunity for students to experience the challenges of and develop skills in system engineering by accomplishing realistic missions with autonomous vehicles in the maritime environment and to foster ties between young engineers and the organizations developing Autonomous Surface Vehicle (ASV) technologies. The competition is comprised of two parts: design and performance. The design part is based on an innovative system concept, rigorous engineering, and the well-crafted construction of a functional vehicle to perform the mission. The performance part is an in-situ demonstration of the vehicle's capabilities to execute specified mission tasks.

## 1.2 Teams:

To field a competitive vehicle, a range of cross-disciplinary skills will be required. A team of people best accomplishes this synergy. Teams may be a combination of students, faculty, industrial partners, or government partners. Students may be high school, undergraduate and/or graduate students. Full-time students must compose at least 75 percent of each team. Full time students must be enrolled at their schools in full time status during winter and spring quarters/semesters immediately prior to the competition year. The student members of a team must make significant contributions to the development of the vehicle. One student member of the team must be designated as the "team leader". The team leader, and only the team leader, will speak for the team during the competition runs. As the team leader will be the sole responsible for speaking for the team, we recommend that the team leader be fluent in English. If your team has no fluent English speakers, please contact the AUVSI staff as soon as possible so that we can plan for communication accommodations. Only the student component of each team is eligible for the cash awards.

## 1.3 Location and Facilities:

The competition will be held at the Founder's Inn and Spa's pond from 8-14 July 2013. Team check-in and registration will be at the hotel on Tuesday 8 July 2013 beginning at 1000 hrs.

The Founder's Inn is a hotel in Virginia Beach, VA that has a large fresh water pond on-site. The pond has an average depth between 5-12 feet and features a water fountain (cannot be removed). Consider the water fountain as a natural obstacle and avoid it at all costs. See the [competition pond](#) on Google Maps.

A tent (10 by 10 foot or equivalent space) will be provided at the location for each team to have a covered work area. Electricity and Internet access will be provided in each tent. The team members, the vehicle and any posters/promotional materials developed for the competition are expected to be onsite (tent/pond area) from the start to the end of each competition day. Since the public and industry representatives will be invited to attend the competition, we strongly suggest that team members who may be interested by internship or employment opportunities bring copies of their resumes onsite.

## 2 General requirements

- R1. **Autonomy:** the vehicle must be fully autonomous and all decisions must be taken onboard the ASV.
- R2. **Buoyancy:** the vehicle must be positively buoyant and be buoyant for at least 30 minutes in the water.
- R3. **Communication:** the vehicle cannot send or receive any information while in autonomous mode\*.
- R4. **Deployable:** the vehicle must have its own 3 or 4 points harness for crane deployment.
- R5. **Energy source:** the vehicle must use self-contained electrical energy source. Sailboats are permitted.
- R6. **Kill Switch:** the vehicle must have at least one 1.5in diameter red button located on the vehicle that, when actuated, must disconnect power from all motors and actuators.
- R7. **e-Kill Switch:** in addition to the physical kill-switch, the vehicle must have at least one remote kill switch that provides the same functionality.
- R8. **Payload:** the vehicle must have a place to mount a payload up to a 60-inch cube weighing up to 5lbs.
- R9. **Payload location:** the payload must have an unobstructed view of the sky and front of the vehicle.
- R10. **Propulsion:** any propulsion system is fine (thruster, paddle, etc), but moving parts must have a shroud.
- R11. **Remote-controllable:** the vehicle must be remote-controllable to be brought back to the dock.
- R12. **Safety:** all sharp, pointy, moving, sensitive, etc parts must be covered and clearly identified.
- R13. **Size:** the vehicle must fit within a six-foot long, by three-foot wide, by three-foot high "box".
- R14. **Surface:** the vehicle must float or use ground effect of the water. Mostly submerged/flying is forbidden.
- R15. **Towable:** the vehicle must have designated tow points and a tow harness installed at all times.
- R16. **Waterproof:** the vehicle must be rain/splash resistant. The competition is held "rain or shine"!
- R17. **Weight:** the vehicle must be 140 lbs or less.

\* = **With the exception of communications for reporting the 'Hot Suit' target**

## 3 Notable changes from 2012 rules

- All teams are expected to provide a digital copy of the video footage analyzed by their vehicle at the end of each time slot, the digital copy can be handed over manually (flash drive, upload to a FTP site, etc).
- The navigation challenge is now optional. However, if you go through it, your challenge station score can be doubled tripled or quadrupled depending on how many pairs of buoys you go through.
- We will provide a GPS coordinate for each challenge station. The coordinate will be in the middle of the area where the challenge station will be.
- One of the new stations involve capturing a flag from a floating or slow moving remote controlled boat.
- Another new station involves shooting a foam arrow/missile through 24in plastic hoops.
- We may supplement the Open Test area vehicle deployment systems with a manually operated crane.
- The width of your wheeled cart/trailer must not exceed 44in at the base (first feet above the ground).
- This is not a new rule, but due to some excessively big journal papers last year, judges will enforce the 10 pages limit on Journal Paper and ignore any pages after the tenth one. Considering adding additional details/content to your website rather than journal paper.

### 4 Mission description

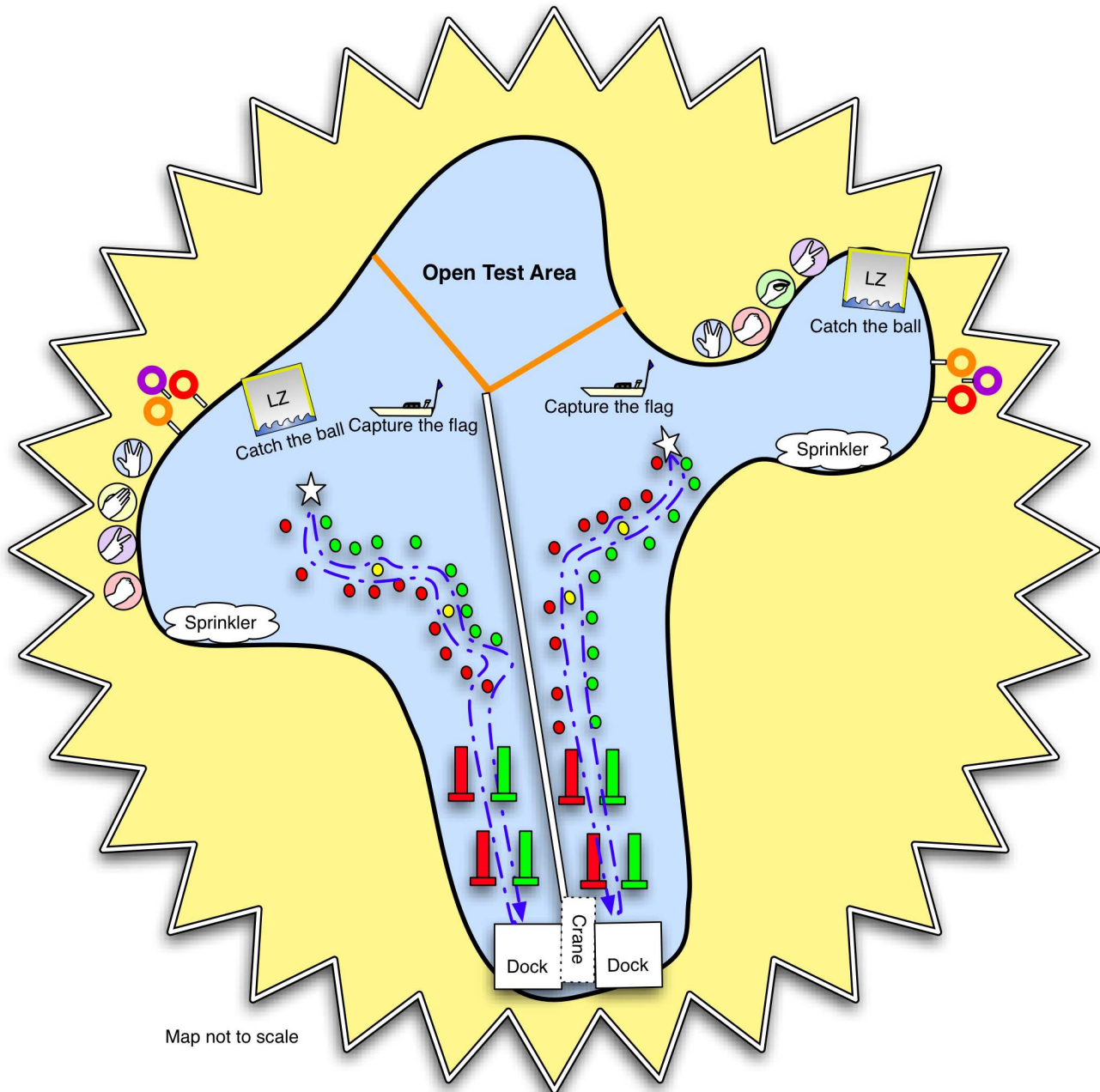
The 2013 mission consists of three (3) sets of tasks.

The first set is the mandatory tasks set and include demonstrating your strength (via a propulsion test), demonstrate ability to navigate by passing the starting gate, and finally demonstrate speed by passing through the speed gate.

The second set is optional and if you choose to do it, it will act as a multiplier for the points from the third set. The sole task for the second set is to go through the navigation channel.

The third set is also optional and include all challenge stations. All challenge stations are optional and can be attempted in any order. You can retry any challenge station as many times as you want (or until your time runs out).

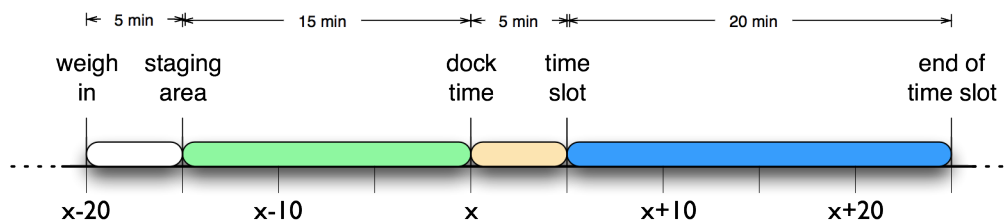
Below is a diagram showing the layout of the different tasks. Note that the diagram is neither exact nor to scale.



## 4.1 Mission attempt

Each team will be allocated a contiguous block of time for each attempt at the mission. The following terms are used to define a “performance”:

- ‘time slot’: The contiguous block of time allocated to a team to attempt the mission.
- ‘dock time’: Period of time prior to the time slot where the vehicle is in the water at the dock.
- ‘start time’: The time at which the dock time of a team is scheduled to start
- ‘run’: A run of the vehicle (in autonomous mode) trying to accomplish the mission.



### Legend

x : start time announced for time slot

The team and their vehicle are expected to be present in the staging area next to launching ramp fifteen (15) minutes prior to the start time in a mission ready state. Teams are expected to have completed a dry vehicle weight measurement prior to moving their vehicle in the staging area.

The time slot is preceded with five (5) minutes of dock preparation time. This dock time can be used for final preparation with the vehicle in the water and for strength/propulsion measurement. The dock time ends when the vehicle leaves the dock on its first autonomous run or when the five (5) minutes are elapsed.

For 2013, each time slot will be a contiguous block of twenty (20) minutes in which the team is allowed to make as many runs as they choose to. Every time a new run is attempted during time slot, all points accrued in the previous run(s) are voided. The vehicle run ends when any of the following occur:

- The time limit for performance period ends.
- The judges order the end of the mission.
- The team leader requests the end of the mission.
- The ASV leaves a competition circuit (entering other competition circuit or open test area)
- The ASV loses its camera payload

All vehicles must be remote-controllable to be brought back to the dock on their own. If a vehicle cannot be remote-controlled (due to failure, etc) an AUVSI staff member will tow back the vehicle. The clock will not stop for the vehicle to be driven or towed back to the starting dock. Only in cases of failure of the mission obstacle(s) or on the explicit request of a judge will the time slot clock be stopped. The time limit is subject to change depending on the number of contestants and may be modified between rounds (practice, qualification, finals) but the amount of time given will be the same for all teams within a round of the competition.

Unlike qualification and final time slots, during test time slots, teams are given a fixed block of time including time to have the vehicle in & out of the water and dock time in order to maximize number of time slots on test days. More details about test time slots will be provided at the orientation meeting.

## 4.2 Two competition circuits

As illustrated in the mission diagram above, we will offer two (2) complete and mostly similar competition ‘circuits’. Each side (Separated by the vertical white line in the diagram above) of the pond will contain a full competition circuit. If obstacles from each circuit are less than 10 feet apart from each other, a series of white Polyform A-2 buoys may be added between the two circuits to create a dividing line. Any vehicle that ventures out of its circuit or start interacting with obstacles from the other circuit will be stopped (using the remote or physical kill switch). Test time slots can be scheduled on either side at the team discretion (and on availability). Qualification time slots will be distributed evenly on both circuits (either all teams have both time slots on the same circuit (while the other one is used for more test time slots) or all teams have one time slot on each circuit). Finals will be held in a single circuit for all teams (the other circuit will be unavailable during finals).

### 4.3 Open Test area

In addition to the two competition circuits, an Open Test area is offered once again for in-water testing. Below are the rules of the Open Test area in bullet-point format:

- All Open Test area rules are subject to changes without notice
- **Content:** Variable. All the spare obstacles (buoys, spare challenge station obstacles, etc)
- **First-come, first-served:** There is no signup list or reservation. Bring your vehicle there when you are ready
- **Deployment method:** The deployment strategy used is left to the AUVSI staff member in charge of the area
- **Deployment/run time:** Variable. Also left to the AUVSI staff member in charge of the area
- **Layout:** Variable. We will do a best effort to make all obstacle available in a way similar to the real courses
- **Number of vehicles in the water:** Variable. Also left to the AUVSI staff member in charge of the area
- **Stay in the Open Test area:** Any vehicle venturing off the Open Test area will be promptly stopped
- **Towing:** Vehicle incapacitated will be towed as soon as possible but priority goes to vehicle on real courses

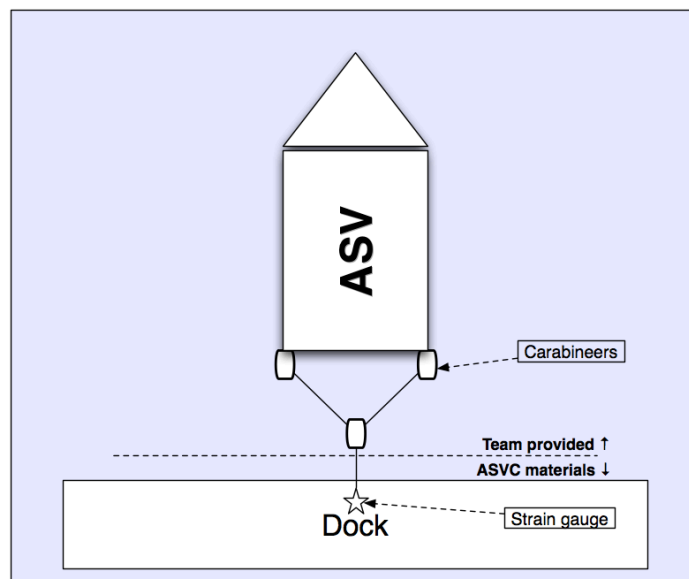
**Note:** Since the obstacle used there are the backup obstacles for the two competition circuits, we may need to remove some obstacles from the Open Test area to replace damaged obstacles from the competition circuits. The exact content of what is deployed in the Open Test area is therefore subject to change with little or no notice.

## 5 MISSION TASKS

### 5.1 Mandatory tasks

#### 5.1.1 Demonstrate your strength

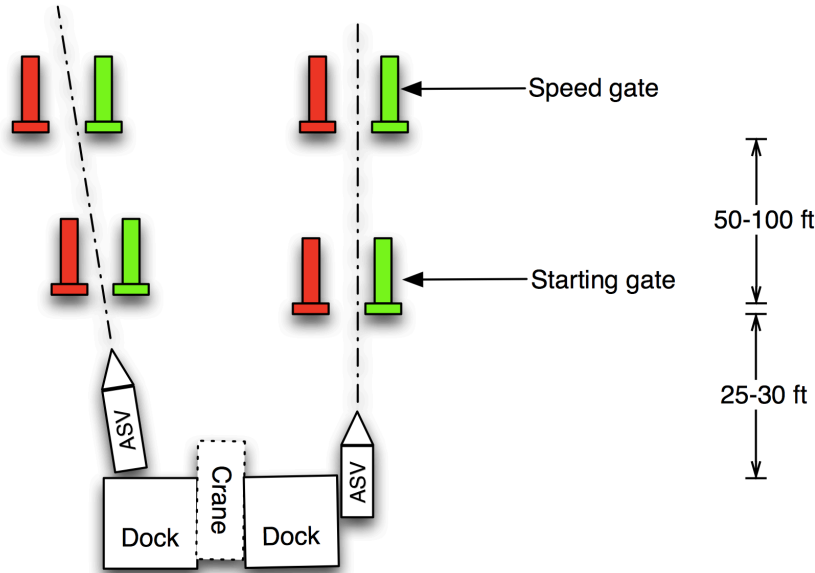
You will start by demonstrating the thrust of your ASV can generate by hooking up your vehicle to a thrust measurement system (see Thrust measurement harness diagram). Your vehicle will then generate as much thrust as possible in 10 seconds. This task can be accomplished in a manned manner (you can use a remote, laptop or buttons on the ASV to start/stop this task). See the figure below for the suggested harnessing mechanism between the strain gauge and your ASV. You must provide a harness attached to two points on your vehicle and which offers a single carabiner or loop as the strain gauge interface.



#### 5.1.2 Demonstrate speed

The vehicle should pass through the starting gate demonstrating the ability to steer a steady course and control speed up to a second gate, the speed gate. The starting gate will be in a fixed position with an orientation of about 25-30 feet (7.5-9 m) away from the dock throughout the competition. The speed gate will be 50-100 feet (15-30 m) away from the starting gate. A 'gate' is a set of two navigation buoys approximately 6 feet apart from each other. The buoys used will be Taylor Sur-Mark Marker buoys #950400 & #950410 (49" in tall, 10-18" in

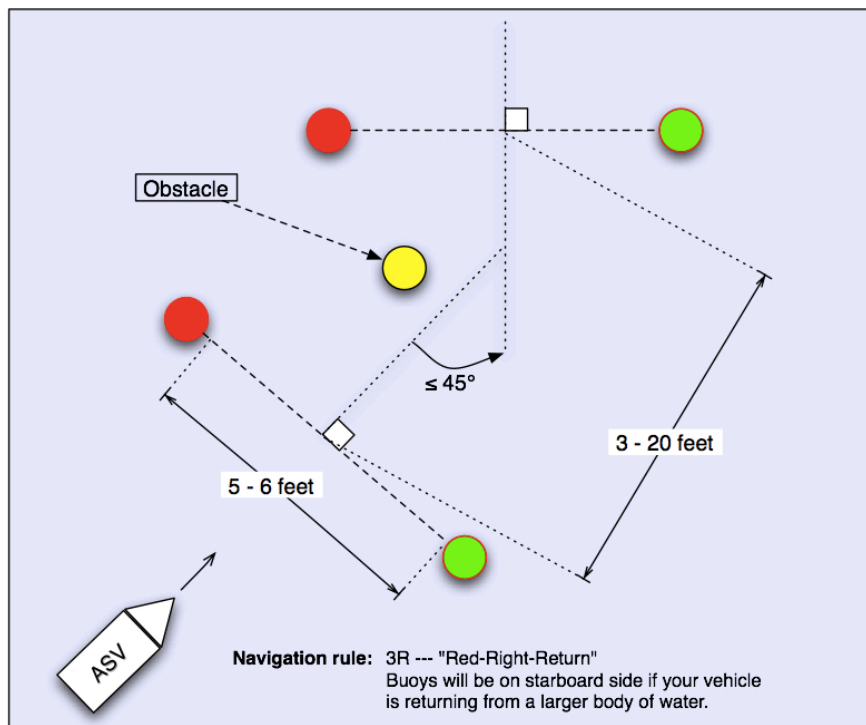
diameter). Your vehicle will be timed on how long it takes to transit between the starting gate and the speed gate. The gates will be positioned such that you can aim to pass both gates using a straight line from the dock.



## 5.2 Multiplier tasks

### 5.2.1 Navigate the channel

The entrance of the navigation channel will be outside of the speed gate. The navigation channel is delimited by sets of red and green navigation buoys (see Navigation channel diagram). The buoys model used will be Polyform A-0 (red and green). The buoys will be placed in such a manner that you can use the 3R navigational mantra (red-right-return). Follow the navigation channel while avoiding the yellow buoys marking obstacles (also Polyform A-0). The end of the channel is marked by a large blue buoy (Polyform A-2). If you pass through at least 3 buoys pairs and avoid all obstacle buoys, your challenge station score will be double. If you pass through more than half of the buoys pairs and avoid all obstacle buoys, your challenge station score will be tripled. If you pass through all buoys pairs and avoid all obstacle buoys, your challenge station score will be quadrupled. The multipliers are not additive and only the greater one for which your qualify will be used.

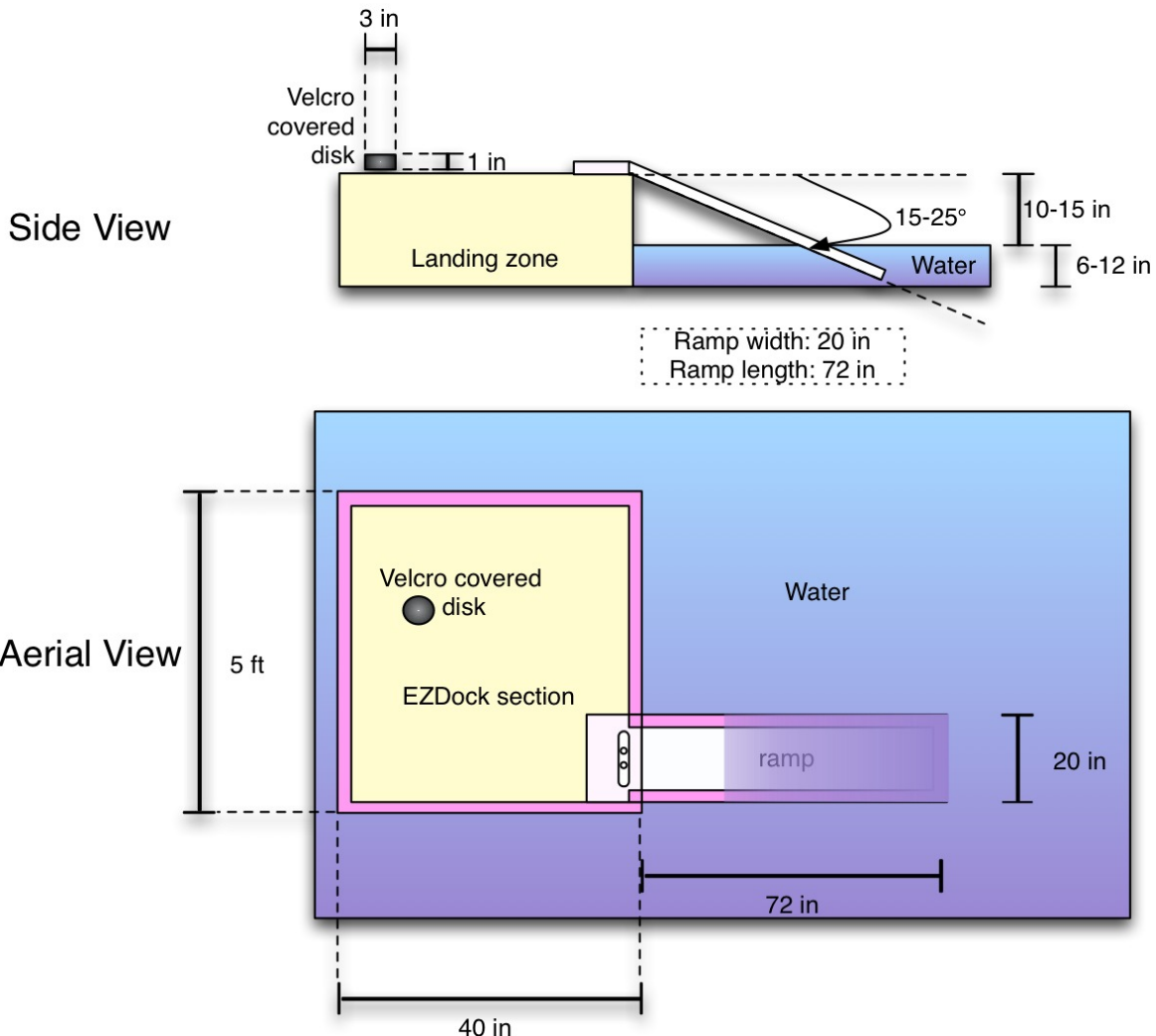


### 5.3 Challenge stations

There will be five challenge stations for 2013. They can be attempted in any order as soon as you have completed the speed gate.

#### 5.3.1 Catch the ball

At the given GPS coordinate, your vehicle may locate a landing zone and make contact with it. From there your vehicle, or subsystems deployed by your vehicle, will have to go up the landing zone incline (20-30°) and retrieve the treasure (a 3in x 1in black velcro (loop side) covered disc). The ramp for the landing zone will be at least 20in wide. The landing zone will be 40in x 5ft and is light beige colored (EzDock section color). The edge of the landing zone and the ramp will be marked by pink duct tape (<http://www.amazon.com/dp/B0052VR1X6/>). If you opt to deploy subsystems from your vehicle, you must retrieve every piece of material that has been deployed or you will have to forfeit all the points accrued for the catch the ball task. Judges reserve the right to end a run if the vehicle leaves the landing zone without retrieving all the material deployed (ex: if the ASV leaves a navigation helping device on the landing zone).



In order to earn points for the Catch the Ball challenge stations, the velcro covered disk must be retrieved and stays onboard your vehicle until the end of the run. In addition you vehicle must either (a) entirely leaves the water to retrieve the treasure, (b) stays in the water, but deploys a self-propelled aerial or ground vehicle to retrieve the treasure. Any other mechanism to retrieve the treasure that involve a vehicle still in the water without deploying a self-propelled vehicle will not be granted any points (such as crane, telescopic arm, robotic arm,

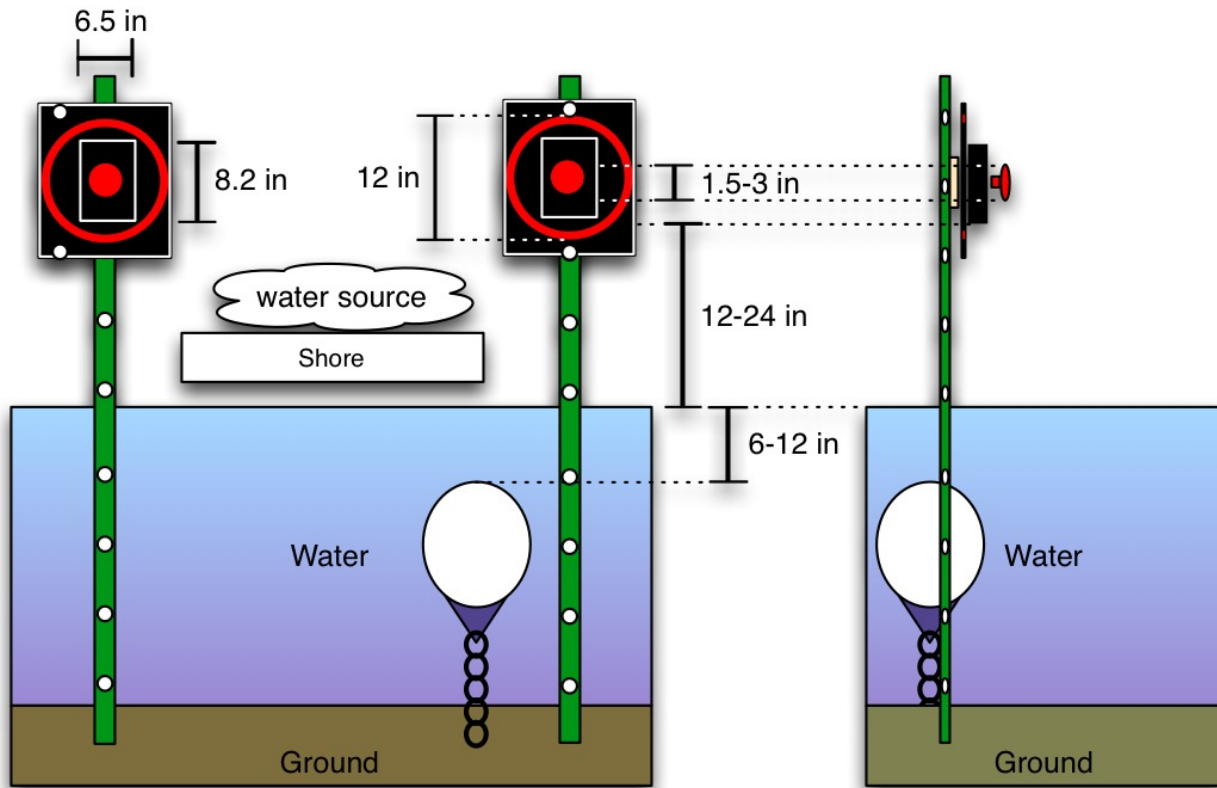
etc). For the duration of the attempt at this station, the “surface” general requirement is lifted (it will be strictly enforced once again as soon as you leave this station). The ‘competition area’ rules will also be relaxed during the duration of the amphibious landing task to let you deploy subsystems into the landing zone as long as all these subsystems are retrieved by your vehicle before leaving the landing zone. Finally, for the duration of this challenge station, the ‘autonomous control requirements’ rules will be also relaxed if you choose to deploy subsystems in the landing zone by letting you remote control these subsystems from the “mothership” (they can either be autonomous or remote controlled by commands originating from the “mothership” but not by outside computers or team members) as long as all the parts are retrieved before leaving the station.

**5.3.2 Sneaky Sprinkler**

The Sneaky Sprinkler task for unmanned vehicle is all about figuring out how to turn on the sprinkler rather than be surprised by it. At the given GPS coordinate, will be two red buttons mounted on a metal pole. A white Polyform A-0 buoys will be placed fully submerged next to the pole holding the ‘active’ button. The button on the other pole will be considered ‘inactive’. The top of the buoy will be 6-12in below the surface. The button will be position 12-24in from the water surface (directly over the water). The button will be an Emergency Stop button with a diameter 1.5-3in. The box on which the emergency button is placed is a black Pelican case 1120. To indicate when you win the sneaky sprinkler task, water fountain will be triggered as soon as the active button pressed (water debit will be limited to < 1 gallon/s).

Front View

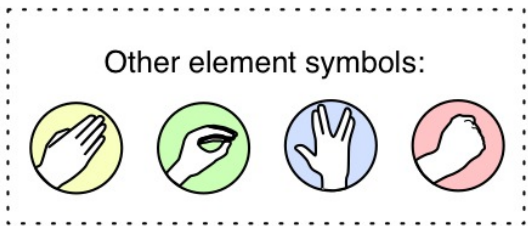
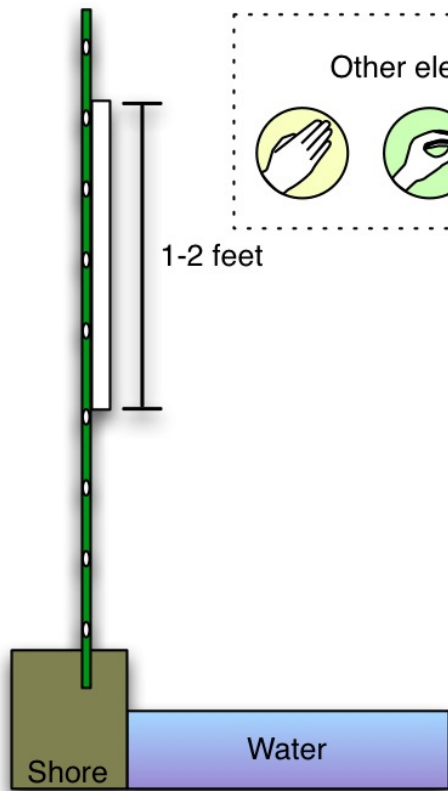
Side View



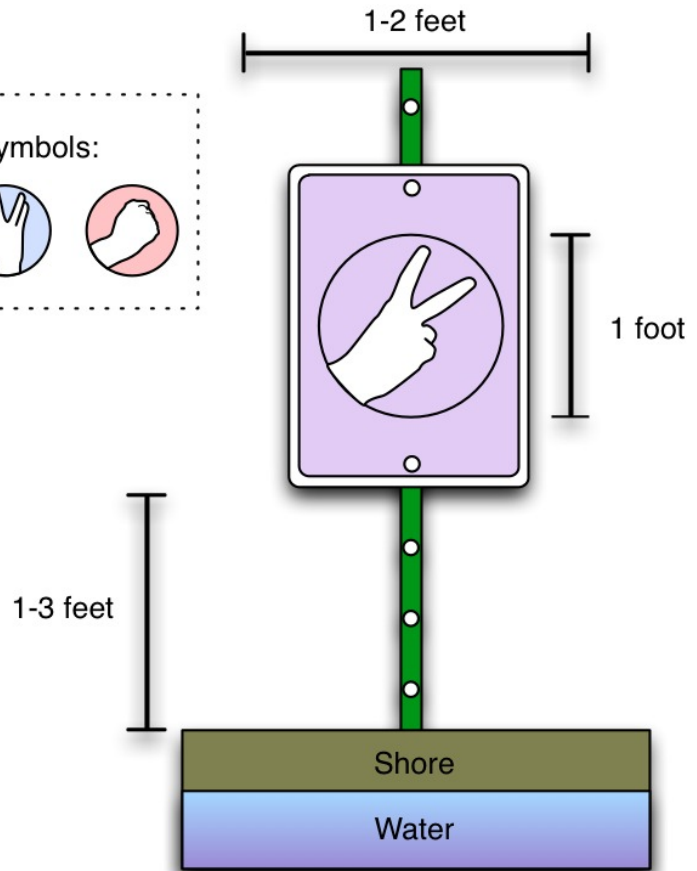
### 5.3.3 The 'Rock, Paper, Scissor, Lizard, Spock' station

At the given GPS coordinate, your vehicle may locate a set of four signs (similar to stop sign but with a custom color) between two (2) feet and five (5) feet above the water level. Each target will be marked with one of the five symbols from Rock, Paper, Scissor, Lizard, Spock (randomly chosen). The sign will be printed on ~1/8in thick aluminum metal plate. Each target will be 2-12 feet away from the next one. One of the targets will be 'hot' (20C+ degrees warmer than the other ones). The targets will be directly facing the water and will be ground based (on the edge of the shore). Report the name of a symbol that would beat the one that is warm along with the GPS position of the warm symbol sign. The competition organization will provide an 802.11g 2.4Ghz wireless network for reporting the hot target. This network is expected to be used solely for reporting 'Rock, Paper, Scissor, Lizard, Spock' challenge and not for other purposes (incl. telemetry, remote control, etc). The exact IP of the reporting server will be posted on the information whiteboard at the competition sit.

Side View



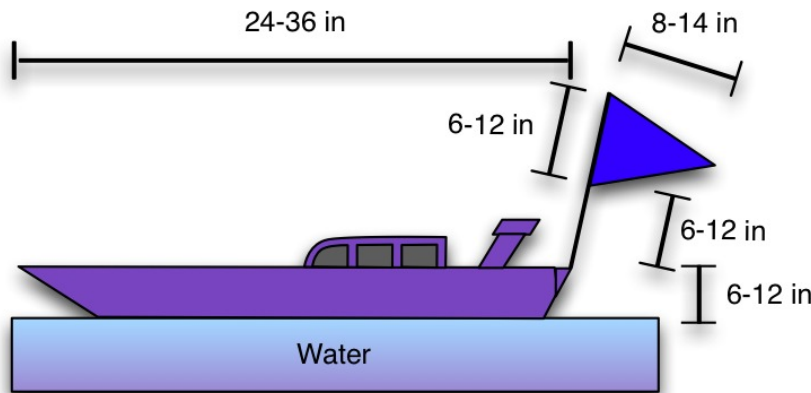
View from the water



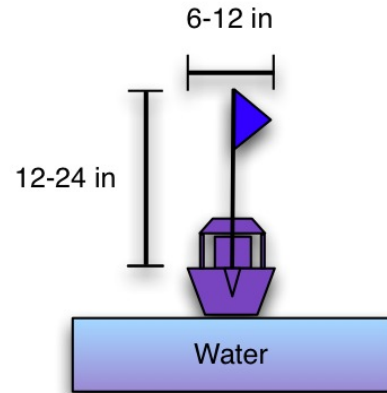
### 5.3.4 Capture the flag

Your vehicle may locate a floating or slow moving boat around the given GPS coordinate. Note that since the boat will be floating or moving, the given GPS coordinate will be approximate and you will need to explore a radius of up to 150 feet around this coordinate. The boat is 24-46in long by 6-12in wide and will be painted plum purple (<http://www.walmart.com/ip/17211054>). The boat will be surrounded by a foam bumper/float (also purple). The boat will carry a 6-12in tall by 8-14in long blue flag on a 12-24in flexible plastic pole. You must approach the boat and steal the flag. The flag will require less than 3lbs of force to be released from the boat. Note: your vehicle will be considerably larger/sturdier than this floating boat. Please avoid making contact with the boat to prevent damaging it.

Side View



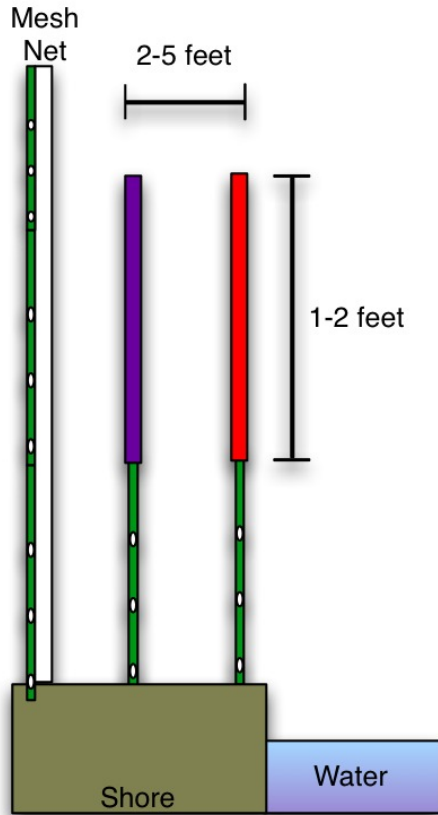
Back View



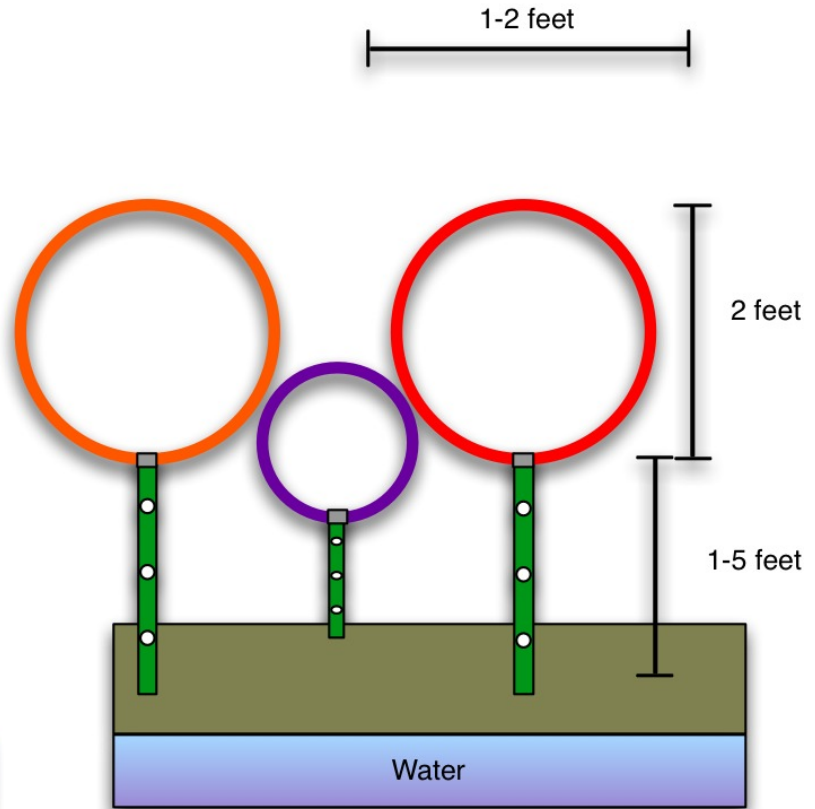
**5.3.5 Shoot through the hoops**

At the given GPS coordinate, you will find 3 colored hoops mounted a pole. There will be an orange, a red and a purple hoop. The orange and red ones will be by the water while the purple one will be 2 to 5 feet further from the shore. The hoops will made of 24" Pull Buoy Inc Deluxe Hoops (<http://www.amazon.com/dp/B002NL0OUK/>). To complete this challenge task, you must shoot a foam arrow/missile through the hoops. The arrow/missile must be shot using compressed air (cannot be self-powered or using any type of combustibile materials). The arrow/missile must be entirely made of foam (no wood, metal, ceramic, hard plastic, etc). We strongly recommend using Nerf arrows/missiles or similar toys (ex: <http://www.hasbrotoyshop.com/nerf-big-bad-bow-arrow-refill?BR=582&ST=SO&PG=1>). A light beige/white mesh net may be installed several feet being the hoops to catch arrow/missile and protect the visitors/staff. Your vehicle can carry a maximum of 6 pieces of arrow/missile for any given run. Points will be given for the first two arrow/missile shot through each hoop. Shooting arrow/missile through the purple hoops that is installed further from the shore is worth more points that shooting through the red and orange hoops that are installed closer to the shore. Shooting at least one arrow/missile through all 3 hoops will grant you a 500 points bonus.

Side View



View from the water



**5.4 Return to the dock to cash in**

If you have reached the challenge station and attempted at least 3 stations, you qualify for a bonus task! The bonus task is to return to the dock in autonomous mode going through the navigation channel passing through at least 3 sets of buoys and navigating in the general direction of the navigation channel. Note that the 3R Navigation mantra still applies, but since you will be returning, the red buoys will be on the starboard side of your vehicle. You accrue points for every buoy pair you pass through on your way back to the dock and earn 500 points if you make it back to the dock (or within a 10ft radius from the dock).

## 6 Rules

### 6.1 Administrative rules

A completed *Intent to Compete* form, available on the website, must be submitted. The submission must be in English and is not considered official until the entry fee of five hundred (\$500) U.S. dollars has been received by AUVSI. As the competition format cannot handle an unlimited number of entries, the organizers reserve the right to limit the total number of entries that are allowed to compete by declaring the competition closed to new entries before the deadline. As with all official information, this announcement (should it be necessary) will appear on the official website and/or forum.

### 6.2 Journal Paper

Teams must submit a journal paper, a presentation video and a website for evaluation by the judges. The journal paper should describe the design of the vehicle and the rationale behind the design choices. This paper length is limited to 10 pages long including all figures, references, and appendices. If the paper exceeds 10 pages, the judges may decide to ignore the content of the exceeding pages. Each journal paper must include an abstract of no more than 250 words. The journal paper and abstract must be formatted for standard 8.5 × 11-inch paper, with margins of at least 1 inch on all sides, and all text must be in 12-point or larger font. Each page must bear footer with the page number and the team name. The journal paper will be evaluated as described below in the section on scoring. The journal paper must be received in Portable Document Format (PDF) via email to the AUVSI Administrative/Logistics point of contact (see front page of the rules) and posted on the competition forum. Teams that do not meet the deadline may be subject to penalties (including disqualification).

### 6.3 Static judging presentation

Each vehicle will be subject to static judging before being allowed to compete. During the static display time, judges, public, press, and other organization representatives will listen to a presentation from each team. Audio/Video equipment will be provided in the static judging area (i.e.: PowerPoint (or equivalent) and multimedia presentations are encouraged). The judges will evaluate each vehicle for technical merit, safety, and craftsmanship as described below in the section on scoring. Each team is required to have at least one member attending their vehicle throughout entire competition. Teams are strongly encouraged to make a poster describing the vehicle. The posters can be set up next to the vehicle during the static display period. Representatives of the press and of other organizations will be encouraged to visit each team during this period.

### 6.4 Introduction video

Teams must submit an introduction video. All submitted team videos must be under 3 minutes long. Your video shall be generated using the following compression options:

- Format: Quicktime
- Compression- H.264
- Limit Data Rate: 2200 Kbps
- Sound: MPEG-4 AAC
- Frame Size: Unscaled

The AUVSI Foundation video crew suggests that you use [MPEG Streamclip](#) to export your video in the above format. To submit your video online please visit:

<https://www.yousendit.com/transfer.php?action=dropbox&dropbox=500films>

## 6.5 Scoring

Each of the tasks has a point value associated with it. The tasks must be completed in order. Additional points will be awarded if you can get back to the dock early. At any point in time, a team can terminate its run. If there is time remaining, they can opt to start a new run. Please note that all points allocated for a run will be lost if a new one is started. Thrust test points can be carried over during a phase of the competition (test, qualifications or final) if no noticeable changes to the propulsion or battery system occurred unless the team decides to do a new thrust test.

**Table 1: Static judging scoring sheet**

Subjective Measures	Max. Points
Utility of team website	50
Technical merit (from journal paper)	50
Written style (from journal paper)	50
Technical accomplishment (from static judging)	75
Craftsmanship (from static judging)	75
Team uniform (from static judging)	10
Video quality (from introduction video)	25
Discretionary static points (awarded after static judging)	40
<b>Total</b>	<b>375</b>

**Table 2: Performance judging scoring sheet**

Performance Measures	Max. Points
Weight	See Table 3
Generate F pounds of thrust (thrust measurement lbs)	$(F / \text{weight}) * 100$
Pass through the starting gate	100
Navigate from Starting to the Speed gate in T seconds	$250 - T$
Enter navigation channel	50
Navigation channel multiplier	[1, 2, 3, 4]
Successful dock & deploy or go up the ramp at Catch the Ball station	1000
Return back to water with foam disk	2000
Sneaky Sprinkler station	1000
Rock, Paper, Scissor, Lizard, Spock station	1000
Capture the flag station	3000
Shot T arrow/missile through the orange hoop	$T * 100$
Shot T arrow/missile through the red hoop	$T * 100$
Shot T arrow/missile through the purple hoop	$T * 250$
Shot at least one arrow/mission through each hoop	500
Be the only team/vehicle to attempt a challenge station (bonus) *	500
Navigate through X buoy set in the channel while returning to dock	$X * 50$
Avoid N obstacles in the navigation channel while returning to dock	$N * 100$
Make it back to the dock	500
Finish All Tasks with T minutes Left on Clock (whole + fractional)	$T * 100$

\* = If a team is the only team to have attempted a specific challenge station during a stage of the competition (qualification or final), they will be awarded 500 bonus points for that station irrespective of whether or not they succeeded.

The mandatory tasks (thrust measurement, starting gate, speed gate) must be completed in order to accrue challenge station or optional task points. The challenge stations can be attempted in any order during a run within the time slot time limit.

### **6.5.1 Challenge station attempt definition**

If a team is the only team to have attempted a specific challenge station during a stage of the competition (qualification or final), they will be awarded 500 bonus points for that station irrespective of whether or not they succeeded. In order to earn these points and what the vehicle does be considered an attempt, the following criteria must be met:

- The vehicle shall make physical contact with the an obstacles for in-water challenge stations
- The vehicle must have all necessary equipment to complete the task successfully
- For the 'Catch the Ball' challenge deploy something on top of the dock
- For the 'Shoot through the Hoops' shoot an arrow/missile in direction and vicinity of the hoops
- For the 'Catch the flag' challenge get within 3 feet of the boat while moving purposefully in direction of the boat
- For the 'Sneaky Sprinkler' challenge make contact with the one of pole/button/box.
- For the 'Rock, Paper, Scissor, Lizard, Spock' challenge be in front of and looking at the warm sign when reporting results

## **6.6 Interference**

Vehicles that interfere with competition elements may be disqualified at the judges' discretion. "Interference" does not include cases where, in the opinion of the judges, a vehicle is attempting to complete one of the tasks. If a vehicle becomes entangled on a competition element, the run will be declared complete. Teams may keep the points earned on that run, or may have the vehicle untangled to return it to the dock and start another new run. If a new run is begun, all points from the previous run are lost. If the competition course is degraded by the elements (damaged, flipped over or adrift element of the course) the team leader may ask, at that time, the vehicle returned to the dock, and for the judges to add back to the clock their best estimate of the time used in that run up to the point of interference.

## **6.7 Communications during the run**

Communication with the vehicle during the run is strictly forbidden with the exception of the message to report the location of the 'hot' target. Any running laptop/computerized device connected (wired or wireless) to the vehicle must be left on the dock table. The remote control (for bringing the vehicle back) must be handed over to the designated ASVC official during the run. The official will follow the team leader and will hand over the remote if asked to do so. Handing over of the remote control will terminate the run.

## **6.8 Competition phases**

### **6.8.1 Practice Runs**

The technical director or the designee will schedule practice time slots on an ad hoc basis during the two practice days. It is our intent to provide as much practice time in the arena as is practical and to ensure minimal idle time for the arena. Each vehicle must successfully pass the safety inspection before it will be allowed into the arena. If the vehicle propulsion system or if any other major components are altered, a new safety inspection will be required. Please plan to arrive in the staging area at least 10 minutes prior to your run to do a safety inspection.

### **6.8.2 Time Slots for Qualification Runs**

The team will select their Qualification time slots in the order of static judging score (see Table 3). The team that is in first place will have first choice, etc. Ties will be broken by a coin toss or random draw. Time slots may be exchanged between teams if both team leaders agree and at the discretion of the judges and AUVSI officials.

### **6.8.3 Qualifying Round of the Competition**

Each qualifying team will be assigned a time slot to perform the mission. Vehicles will be put into and taken out of the water by tournament officials. The performance will continue until the competition time limit has

expired, or the team leader requests the end of the mission, or the judges order the termination of the run. The judges may order termination of the mission at their discretion. Once the judges order the end of the mission, no further points may be scored. The judges' decision on the termination of the run is final. If the time limit is not exceeded, the team leader may opt to go for another run and thus waive all the points accrued in the previous run. Each team will be given 1 (one) try at the thrust measurement per slot time. Thrust measurement can only be done before attempting any other tasks. The thrust measurement operation can be a manned one (i.e.: command given by a team member to the vehicle using a remote or laptop. Competition officials will operate physical buttons). As soon as the thrust measurement is completed, the vehicle must be returned to autonomous mode. The thrust measurement can be completed as part of the 'Dock Time' portion of a time slot (if there 'dock time' is not yet elapsed).

#### 6.8.4 Final Round of the Competition

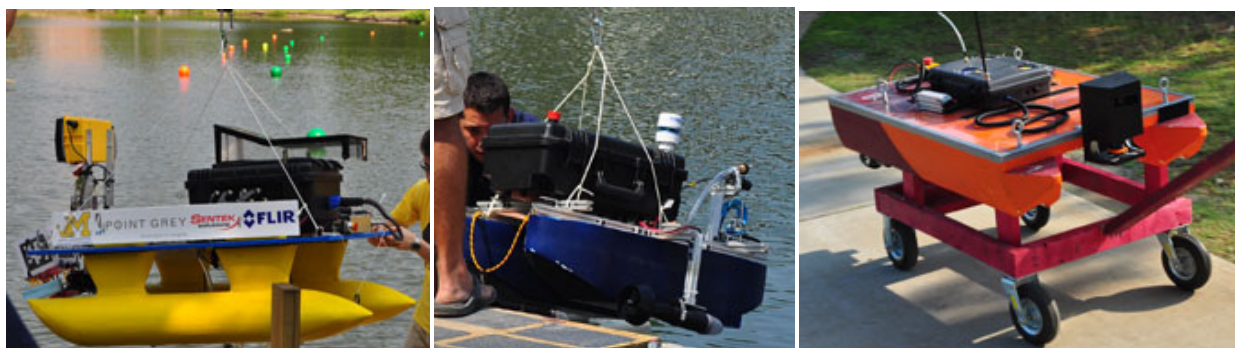
After the preliminary round, the judges will tally their scores. Teams will be accepted into the finals in rank order from the preliminary round. The judges have the discretion to select the number of teams entering the finals that they deem appropriate. We anticipate three to five teams competing in the finals. The finals round will be conducted in the same manner as the preliminary round. Judges and AUVSI staff have discretion to modify the time duration allocated during the final round to have the final format fit with obligations (televised video feed time, publicized final round start and end time, etc) as long as every team is allocated the same amount of time.

### 6.9 Logistic of putting vehicles in the water

In order to make it possible to deploy your vehicle at the RoboBoat competition, your team has to provide both a wheeled cart/trailer and a 3 or 4 points harness.

#### 6.9.1 3 or 4 points harness

4-points harness is preferred over 3-points harness. For your vehicle to be deployed with a crane, your team has to provide a harness custom design for your vehicle. Your vehicle design should include 3 or 4 hook points that are fixed to the vehicle structure. We recommend using  $\frac{1}{2}$  in of diameter (or thicker) nylon rope for the harness. We recommend terminating each end of the harness by a carabiner for quick installation/removal of the harness. To attach the harness to the crane, an additional loop should be created in the middle/upper part of the harness to avoid slipping during deployment. Below are few examples of harnesses used to deploy vehicles in 2011 (from left to right: harness on U of Michigan's vehicle, harness on US Naval Academy's vehicle and preminent hook points on VT's vehicle.



#### 6.9.2 Wheeled cart/trailer with hard-linked handle

All team are expected to provide their own trailer (Suggestions: [garden cart](#), [golf cart](#), [dump cart](#), etc). Trailers will be moved by hand on site (no motor vehicle allowed). A handle system that is connected to the trailer by a solid link (no rope/chain as it cannot be use to back up nor to align the trailer) that exceeds the length of the ASV by 2-4 feet is required in order to move the trailer on the ramp. The width of the trailer at the base (the first feet above the ground) must not exceed 44in to fit on the ramp. All trailers must be

negatively buoyant (sink when put in the water). Below are some examples of wheeled cart/trailer.



**6.10 Time considerations**

Once time is started at the beginning on the run, it will not be stopped (even while the vehicle is returning to the dock). The only exception is if course obstacles are damaged by a natural cause (wind, wave, rain, etc), time might be stopped and a run might be restarted (time adjusted) at judges' discretion.

**6.11 Safety Inspection**

The officials will suspend the operation of a vehicle at any time they deem that it is required for safety or security considerations. All vehicles, regardless of weight, must have clearly marked safe zones to pull to lift the vehicle. Each team will be responsible for manually moving the vehicle (on trailer or similar device) to / from the launch area and the team's designated work area. Vehicles must have readily identified tow points and tow harness on at all time when the vehicle is in the water (for emergency towing). It is the team responsibility to provide a thrust measurement/tow harness. The vehicle must be capable of being towed by a boat using a single line at speeds up to 5 knots when un-powered.

Prior to each time slot, each vehicle may be inspected for safety. The safety inspection will requires every team to identify all underwater moving parts or actuators (propellers, water gun, etc) and their associated protection mechanism (shrouds, etc) in addition to demonstrating the functionality of both the physical emergency stop and the wireless E-Stop. Passing this safety inspection is a hard requirement for being allowed to get in the water. If after successfully passing a safety inspection a change or modification is made to a moving part, actuator or its protection mechanism, a new safety inspection will be required before being allowed in the water. Please be proactive about requesting a safety inspection as it may prevent your time from getting in the water and you may lose your time slot if you do not pass it.

**6.12 Qualification Inspections**

In addition to the safety inspection, the competition judges will evaluate each competing ASV during static judging. Judges will inspect for exposed electronics, fluid leaks, stability, potential cutting hazards, physical E-Stop placement and function, wireless E-Stop operation and towing ability. Judges have the discretionary right to impose penalties (i.e.: loss of points) going up to the disqualification of a team for safety violations.

**6.13 Size and weight limits**

Each ASVC, each entry must fit within a six-foot long, by three-foot wide, by three-foot high "box" (1.83 m x 0.91 m x 0.91 m). Table 3 below shows the bonuses and penalties associated with a vehicle's weight in air.

Table 3: Size and weight constraints on ASVs entered into the 2013 competition

	Bonus	Penalty
ASV Weight > 140 lbs (ASV Weight > 63.5 kg)	N/A	<b>Disqualified!!!</b>

140 lbs $\geq$ ASV Weight > 110 (63.5 kg $\geq$ ASV Weight > 50 kg)	N/A	<b>Loss of</b> 250 + 5 (lb - 110) 250 + 11(kg - 50 )
110 lbs $\geq$ ASV Weight > 70 (50 kg $\geq$ ASV Weight > 32 kg)	<b>Bonus of</b> 2(110 - lb) 4.4(50 - kg)	N/A
ASV Weight $\leq$ 70 lbs (ASV Weight $\leq$ 32 kg)	<b>Bonus of</b> 80 + (70 - lb) 80 + 2.2(32 - kg)	N/A
ASV Dimensions greater than - Width: 3ft (0.91m) - Height: 3ft (0.91m) - Length: 6ft (1.83m)		<b>Disqualified!!!</b>